Firearms Inspection and Troubleshooting

SONORAN DESERT INSTITUTE

SCHOOL OF FIREARMS TECHNOLOGY

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Chapter 1 - Troubleshooting, Maintenance, and Firearm Repair

Introduction

Like any machine, firearms are prone to malfunction and require a certain amount of maintenance. Firearms are also likely to experience parts breakage and require repair. A gunsmith should be able to diagnose any issues that may be caused by the firearm and ammunition or by the shooter themselves. There are certain procedures that should be followed to properly troubleshoot any issues that you may encounter.

Safety first! Use appropriate eye and ear protection.

Safety first! Keep your finger off the trigger until you are ready to shoot.

Firearm Inspection Procedures

Anytime you are working with firearms, safety is the most important consideration. Every aspect of the inspection procedure is designed to ensure your safety and the safety of the operator. The inspection procedure includes an initial safety check, followed by a function check, and finally a test fire.

SAFETY

Working with firearms is not as dangerous as some would assume, but there are inherent dangers that can be nullified with a few basic safety rules. These rules will ensure your safety and the safety of everyone around you at all times.

1. Treat every firearm as if it were loaded.
2. Never point a firearm at anything you do not intend to destroy.
3. Know how to safely operate your firearm and how all of its safeties work.
4. Use appropriate eye and ear protection.
5. Always keep firearms unloaded until ready to use.
6. Live ammunition is not allowed in the work area.
7. Never use live ammunition to function check firearms; use snap caps only.

Because you may have to test fire a firearm to verify function, there are a few more rules to adhere to:

1. Keep your finger off the trigger until you are ready to shoot.
2. Know your target and what is beyond.
3. Always use caliber-correct factory ammunition.

Figure 1: Clearing a firearm.

The first step in preparing any firearm for inspection is to clear it. Clearing a firearm involves removing its feed source, ammunition, and making sure the chamber is clear. Clearing a firearm is always done in the same sequence; failing to complete the sequence in order can lead to a very dangerous situation. The steps to clearing any firearm are:

1. Set the firearm's selector/safety to the "safe" position. Some designs will not allow you to set the safety as it will interfere with clearing the action (i.e. 1911).

2. With repeating and semi-automatic firearms, remove the feed source. This means any box, drum, or detachable tubular magazine. For revolvers, unlock the cylinder or open the loading gate. For firearms that utilize a fixed internal or tubular magazine, unlock and open the action.

3. Unlock and open the action to manually extract and eject any cartridges left in the chamber. If the firearm utilizes a fixed magazine, you may have to manually cycle the action several times before all the cartridges are removed from the action. Once the action is clear, manually cycle the action several more times to verify. For revolvers, use the ejector rod to empty the chambers in the cylinder.

4. Lock the action open (if possible) and physically and visually check the chamber. Use your finger to feel inside the chamber and look to verify it is clear. If the firearm utilizes a fixed magazine, verify the magazine is empty and you can see and feel the magazine's follower.

The firearm is now clear and safe to handle. Remove any live ammunition from the workspace and the room to prevent any accidental loading. If there is ammunition left in any feeding devices, remove it as well. If you need to function test the firearm at any point, use snap

Figure 1b: Removing the feed source.

Figure 1c: Extracting and ejecting.

Figure 1d: Action locked open.

caps or "dummy rounds" to ensure you are doing it in the safest way possible.

At some point, you will have to test fire a firearm to verify function. Make certain you are pointing the muzzle of the firearm at an appropriate backstop when loading the firearm and anytime there is a live round in the chamber. Even if you need to hand-cycle live rounds to verify function, always point the firearm at an appropriate backstop.

TOOLS AND MATERIALS

You will need certain tools and material to disassemble and assemble a firearm during maintenance and repair. Make certain you have everything you will need near you ahead of time; you do not want to be looking for a tool while trying to hold another assembly together. A basic tool list includes:

- Hammers and mallets – ball-peen, brass, hybrid and rawhide
- Punches – starter, pin, roll pin, center and drift
- Screwdrivers – flat and Phillips-head
- Wrenches – box and open-ended, adjustable, socket, torque, Allen, torx and strap
- Pliers – combination, slip joint, needle-nose, Channellock, and vise grip
- Picks
- Tweezers
- Hemostat
- Files, stones, and sandpaper
- Clamps
- Vise
- Caliper
- Levels
- Magnetic parts tray
- Sandwich bags
- Shop rags
- Cleaning kit – patches, jags, brushes, rods, cleaner and oil

Figure 2: Basic tools and materials.

- Masking tape
- Small light
- Snap caps
- Specialty tools – barrel and action wrenches, barrel nut wrenches, trigger pull gauge, scale, etc.

FUNCTION AND SAFETY CHECK

The function and safety check is the second step in the troubleshooting and repair processes. The function check is used to diagnose any issues that the firearm may be experiencing. The function check is performed by hand (no live fire) in a controlled environment.

The initial function and safety test should be done "dry," meaning there are no snap caps or live rounds involved. The action is manipulated by hand slowly, paying close attention to the "feel" of the action parts moving together. The parts should feel smooth when moving against each other and there shouldn't be any stoppages or binding. With manual actions, it is easier to work the action slowly in both the unlocking and locking strokes. With semi-automatic firearms, it is slightly more challenging because you are fighting against the action/recoil spring and you hand-cycle the action. Work the action slowly so that you can feel each step of the cycle of operations. There are several steps of the process that you should feel, depending on action type. These things include the following:

- **Unlocking** – When hand-cycling the action, the first thing you should feel is the breech unlocking on almost every action type, except blowback. The action unlocking will feel like light or moderate resistance as the locking lugs/surfaces shear across each other. You will feel the moment the breech unlocks as the bearing surfaces clear each other and the resistance that was felt lessens.

  Outside of feel, you can also hear the sounds of the breech unlocking. You can typically hear the bolt move, camming

Figure 3: Unlocking the breech by hand.

Figure 4: Cocking the hammer.

and rotating inside the carrier or receiver, or the barrel camming and unlocking from the slide. You may also hear various clicks or pings as the action performs other tasks like disconnecting the fire control group (FCG), or moving the elevator/carrier.

Once the breech has unlocked, the feel of the stroke should be smooth until you reach near the end of the stroke. A blowback firearm should feel the same all the way through its stroke, until it reaches the cocking step. Break-action firearms should pivot open smoothly once the top lever is manipulated.

The unlocking step will feel much different for revolvers. Because all of a revolver's action movement comes from the FCG, you will have to dry fire it to verify function. With single-action revolvers, you will need to cock the hammer manually and feel for the cylinder stop to release the cylinder and the finger to turn the ratchet. Cock the hammer slowly until the sear catches and the hammer is trapped. With double-action revolvers, you will have to press the trigger slowly so that you can feel the movement of the action. You may have to use two fingers to move the trigger slowly and really feel the action move.

- **Cocking –** Once the action is unlocked and has reached the end of its stroke, you will feel the FCG cocking. You will begin to feel resistance and you may hear several clicking sounds as the hammer/striker and sear are engaged. The feel of the cocking step will vary depending on whether the firearm utilizes a hammer or a striker.

With a hammer-fired action, the bolt/carrier/slide will engage the hammer almost immediately after unlocking or shortly after. You will feel resistance as the bolt/slide forces the hammer around the hammer pin until the sear engages the hammer and traps it. Depending on the action, you may feel the bolt move past the hammer

as it travels rearward, or you will feel continuous pressure throughout the stroke, like with semi-automatic pistols. Once the action begins its forward stroke, the bolt/carrier may have to ride over the hammer and you will feel slight resistance once more.

With single-action and double-action revolvers, the hammer is manually cocked by pressing against the hammer's spur and forcing the hammer downward until the hammer is trapped by the sear. The hammer should feel very stiff as you overpower a heavy (16 – 20 lb.) hammer spring. With some break-action firearms, the hammer(s) is cocked by a cocking lever. When the action is opened, a lug on the barrel(s) acts upon the cocking lever (in the receiver) and cocks the hammer(s). When you pivot the action open, you can feel slight resistance as the leverage of the barrels and receiver/stock aid in overcoming powerful hammer springs.

With striker-fired actions, the striker will have to ride over the sear on its rearward stroke and be arrested by the sear on its forward stroke. On the rearward stroke, you may feel some resistance as the striker pushes the sear out of the way and you may hear a click as the FCG disconnects and the sear pops back up. On the bolt's/slide's forward stroke, the striker is captured by the sear before the breech closes completely. You will feel slight resistance as the forward stroke of the bolt/slide overcomes the striker spring and cocks it. As you move the bolt/slide forward, you can feel resistance as the striker is pulled rearward, placing tension on the striker spring and cocking it.

- **Locking –** As you continue to drive the action forward, the last thing you will feel is the breech locking. Like unlocking, you will begin to feel a light to moderate resistance as the locking lugs or surfaces engage. With manual actions,

Figure 5: Locking the action.

you will have to force the breech closed with light to moderate force until the action bottoms out and locks. With semi-automatic actions, the action/recoil spring assists with locking the breech. With the action partially locked, release the charging handle/slide and allow the action/recoil spring to lock the breech completely. If the breech does not lock fully, there may be an issue.

Break-action firearms lock when the barrels and receiver are closed and the top lever resets back into its locked position. You can feel the breech lock as you watch the lever move. Revolvers will lock almost simultaneously when the hammer reaches its cocked position. Linkage inside of the frame connects the lock and hammer to ensure there is no out-of-battery discharge. As you manipulate the trigger or hammer, you can hear, feel, and see the lock engage the cylinder.

Now that you have completed a "dry" function and safety check, you can perform the same check using dummy rounds or snap caps. Any issue that did not reveal itself during the initial check may reveal itself during this check. Like the first check, this check is done slowly, examining the snap cap as it travels through the various stages of the cycle of operations.

Unlike the first check, the second check relies more on vision than feel. You can watch the dummy rounds as they complete various stages of the cycle of operations. There are several steps of the process that you should watch, depending on action type. These things include:

- **Feeding –** As you slowly hand-cycle the action, the first thing you will see is the dummy round traveling into the chamber as it is being fed. Depending on the type of action, the round is fed by hand (single-shot) or from a feeding device (repeater). Watch the travel of the dummy round for any hesitation or disruption in its movement.

  With single-shot and revolver actions, you can feel for any resistance as you feed a round into the chamber by hand. You can feel any resistance or snagging from burrs around the mouth of the chamber or from rough machining inside the chamber. If you are using brand new dummy rounds, you may be able to see scratches on it from the rough chamber.

  With repeating actions, you can watch the snap cap as the action feeds it through the cycle of operations. The first thing you will see is the dummy round being stripped from the feeding device (fixed or detachable). Watch as the

Figure 6: Feeding a single-shot and revolver action.

Figure 7: Feeding a repeating action.

breechblock/bolt/slide pushes the round from the magazine or up the lifter/elevator. The round should move smoothly, with little to no disruption as it is pushed from the feeding device, up the feed ramp(s) and into the chamber. As you continue to manipulate the action, you should see the round feed completely into the chamber, seat, and the breech close and lock. If the round is not completely seated, you may see a slight gap in the breech or the bolt handle may not bottom out. You should not have to force the breech closed with a snap cap or dummy round in the chamber; the breech should close with the same amount of force with or without the snap cap. Another thing to watch for is the extractor jumping over the rim of the cartridge with some designs. You may have to force the action forward so the extractor clears the case rim and seats in the extractor groove of the cartridge's head.

Extracting – After the dummy round has been chambered, as you manipulate the action open, you will see the round being extracted from the chamber. As the action moves rearward and the breech opens, you can watch as the extractor pulls the dummy round from the chamber by the head of the cartridge case. The extractor should maintain hold of the case until (and even after) the round has cleared the chamber. The extractor should not slip off of the case rim at any point. The snap cap should move

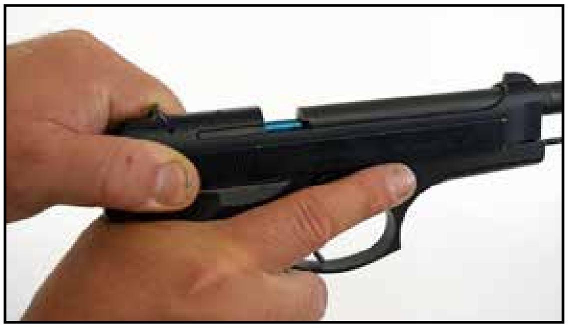

Figure 8: Slowly extracting the snap cap.

Figure 9: Extracting from a break-action firearm.

smoothly from the chamber and should not exert much resistance against the extractor claw.

Break-action firearms will extract as the action is open. Unlike other firearms where the extractor "pulls" the round from the chamber, break-action extractors will "push" the round out. As the action opens, you can watch the dummy round begin to rise as you pivot the barrel around the action. The dummy round is only partially extracted by the extractor; you must extract the round manually. When you remove the snap

Figure 10: Extracting and ejecting rounds from a revolver.

cap from the chamber, there should be no resistance; the round should come out easily.

The extraction step for revolvers occurs when the loading gate (single-action) or cylinder has been opened. When the ejector rod is depressed, you can see and feel the round(s) being pushed from the chamber. With revolvers, extraction is quickly followed by ejection. There should be no resistance (other than the ejector rod return spring) when extracting and ejecting the dummy rounds. Also, because you are manually ejecting the round(s), they will not travel very far.

- **Ejecting** – As you continue the action through its stroke, the next thing you will (typically) see is the dummy round being ejected from the breech. Because you are slowly hand-cycling the action, the round may not travel very far or may just fall from the extractor's claw. It is also dependent on the type of ejector being employed, fixed, or sprung.

  Fixed ejectors, as their name implies, are fixed to the frame or receiver, while the round is pulled into it and ejected. Sprung ejectors are continuously trying to force the round from the breech. A plunger, typically located on the bolt face, is continuously applying force to the head of the cartridge case, while the extractor is pulling against the case head.

Figure 11: Hand-ejecting with a fixed ejector.

These opposing forces make the case pivot around the extractor's claw and "spin" out of the breech.

With fixed ejectors, slowly manipulating the action and trying to eject the round is almost comical. More often than not, the dummy round will slip out of the extractor's claw and fall into the breech before ever reaching the ejector. This applies to both manual and semi-automatic actions. For proper ejection, you will need to accelerate the action so that the round has enough energy to bounce off of the ejector and out of the breech. It is often difficult to gauge the ejection pattern of the firearm when hand-cycling because the snap caps will eject in such an erratic pattern.

With sprung ejectors, you can see the ejector trying to force the case from the breech from the moment the case is extracted from the chamber. If you watch carefully, you will see the ejector force the case around the extractor claw, pushing the case into the side of the chamber and then receiver. Once the tip of the dummy round is clear, the round will be ejected from the breech and away from the firearm. Unlike fixed ejectors, this action can occur during low speed hand cycling. The ejection process is magnified when the cycle is sped up.

Now that you have completed a function and safety check using dummy rounds or snap caps, assuming everything passed, you can now run the same check "at speed." This means you can accelerate the speed at which you manipulate manual actions and you can allow semi-automatic actions to move under recoil spring force. This check may reveal issues that the previous checks did not. Because this check is done at an accelerated pace, it may be more difficult to see or feel what is happening as the dummy round is being cycled, especially with semi-automatic actions.

Figure 12: Hand-ejecting with a sprung ejector.

At this point, the only thing you are checking for is malfunctions. The firearm should perform all of the functions of the cycle of operations without failure. With snap caps, you are looking for failures to feed, extract, and eject. With each type of malfunction, you must diagnose the area of the firearm that caused the malfunction. Things that you should look for include:

- **Failure to Feed** – With a failure to feed malfunction, note the area of the action where the dummy round becomes stuck or has hung up. There are many areas of the action that can cause a failure to feed, including the feeding device or various parts of the action, as well as the ammunition used. Starting with the feeding device, the round can be disrupted by any part of the feeding device, including the body, follower, and magazine spring. Moving into the action, the round may hang up on the feed ramp(s) located on

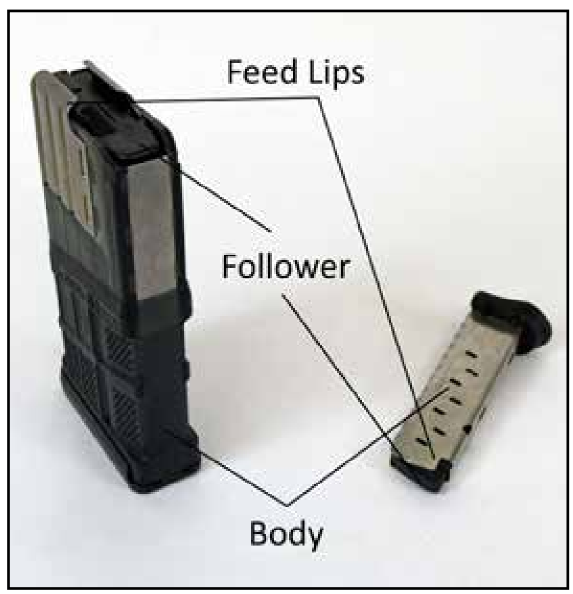

Figure 13a: Causes of failures to feed – feeding devices.

Figure 13b: Causes of failures to feed – firearm.

Figure 13c: Causes of failures to feed – ammunition.

the frame or barrel. The breechblock/bolt/slide can also upset the round's travel. Moving farther, the chamber and locking lugs/surfaces can contribute to malfunctions. Damage, burrs, wear, material failure, tolerance error, dirt, and debris in any of the areas that control feeding can all contribute to malfunction.

- **Failure to Extract –** With failure to extract malfunctions, the number of parts or assemblies that can contribute to the malfunction is much smaller. A failure to extract malfunction may be a result of the chamber or extractor assembly. This

includes the body of the extractor, its claw, and possibly an extractor spring(s). Damage, burrs, wear, material failure, tolerance error, dirt, and debris in any of the areas that control extracting can all contribute to malfunction.

- **Failure to Eject** – Failure to eject malfunctions can only be caused by a limited number of parts or assemblies as well. Typically, only the ejector is responsible for failure to eject malfunctions. This includes the ejector and possibly and ejector spring. Damage, burrs, wear, material failure, tolerance error, dirt, and debris in any of the areas that control ejecting can all contribute to malfunction.

Once the firearm has passed the initial function checks, both dry and with snap caps/dummy rounds, you can now verify both the function and safety of the fire control group (FCG). While the firearm may pass a basic function check, the FCG is a different story. Using snap caps, you can verify that the FCG is functioning properly.

1. With snap caps in the chamber (and feeding device if applicable) and the FCG in the cocked position, set the safety/selector in the "safe" position.

2. Depress the trigger. Depending on the trigger action type (single-/double-action, single-/two-stage), the trigger may move slightly or may not move at all.

3. Release the trigger and move the safety/selector to the "fire" position. Nothing should happen.

4. Depress the trigger once again. The hammer/striker should release, providing an audible "click."

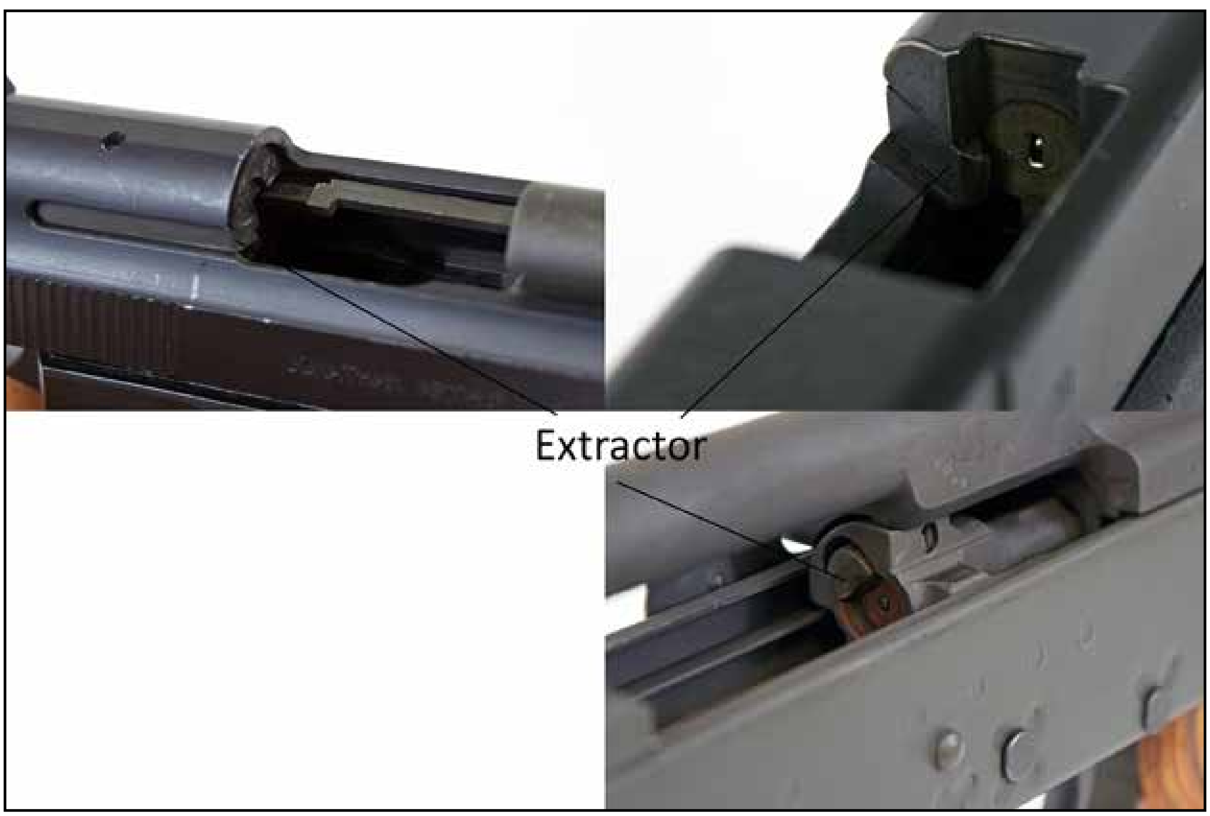

Figure 14: Causes of failures to extract.

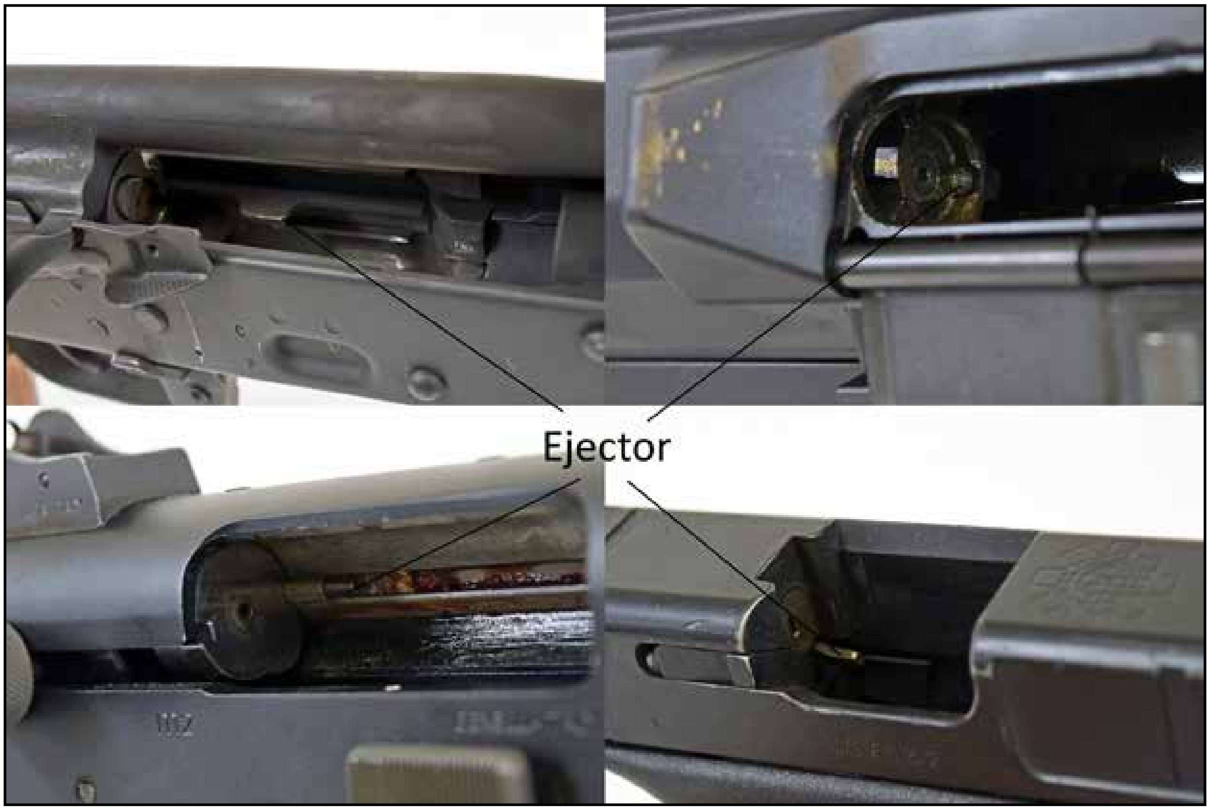

Figure 15: Causes of failures to eject.

5. With repeating firearms, (if possible) continue depressing the trigger as you manually cycle the action, ejecting one snap cap and feeding another. You may hear audible cues as the FCG disconnects and you may feel it in the trigger.

6. Release the trigger. You may hear or feel the FCG resetting in preparation for firing once again. When the trigger is released, hammer or striker should not move.

7. Using a rubber/nylon hammer or rawhide mallet, tap the receiver/action or FCG housing. Use light to moderate force. This simulates being dropped or bounced around. The hammer or striker should not move.

8. Set the safety/selector to "safe" once again. Tap the firearm with the hammer or mallet once more. Nothing should happen.

Firearms equipped with addition (redundant) grip safeties and trigger safeties, as well as out of battery "safeties," require additional safety checks. For these firearms, the check includes the following:

1. With the FCG set to the cocked position and the manual safety/selector set to "fire," depress the trigger without depressing the grip or trigger safety. The trigger may move slightly, but the hammer or striker should not fall.

2. Pull the action slightly out of battery and depress the trigger. The trigger may move, but will feel "free" or "dead" because it is disconnected from the remainder of the FCG. The hammer or striker should not move, even with all safeties deactivated.

Firearms that are equipped with decocker "safeties" can cause some confusion. Often, when the decocker is set to the "safe" position, the

Figure 16: Function checking the FCG.

hammer will fall. This can be alarming if you do not understand how a decocker works. When the decocker is manipulated, a transfer bar that transfers the force of the hammer into the firing pin is removed from the path of the hammer. The body of the decocker features a lug or tab that moves the sear and drops the hammer onto a solid part of the decocker and not the transfer bar. Because these types of systems are almost always double-action, when the decocker is released, the trigger can be depressed and the hammer will fall onto the transfer bar.

Figure 17: Function checking additional safeties.

One final area of the FCG to examine, which is specific to hammer-fired firearms, is the hammer/sear engagement. This can be done with a snap cap and the hammer set to the cocked position. Press against the back of the hammer or lightly tap it with a rubber or rawhide mallet. The hammer should not move. This test may also reveal issues with the hammer/sear angle.

Watching the hammer as the trigger is depressed can reveal clues about the condition of

Figure 18: Function checking a decocker.

the sear and its angle of engagement. Positive sear engagement is considered the safest condition and can be identified by the hammer's slight rearward movement as the sear moves across the hammer's engagement surfaces. Neutral engagement, which is considered to be the best compromise of safety and "feel," can be identified by the lack of movement by the hammer as the sear moves across its engagement surface. Negative engagement, which is extremely unsafe, can be identified by the hammer's forward movement as the sear moves across the hammer's engagement surface.

Figure 19: Checking hammer/sear engagement.

If at any point the firearm does not pass a certain check, delay the remaining checks until the

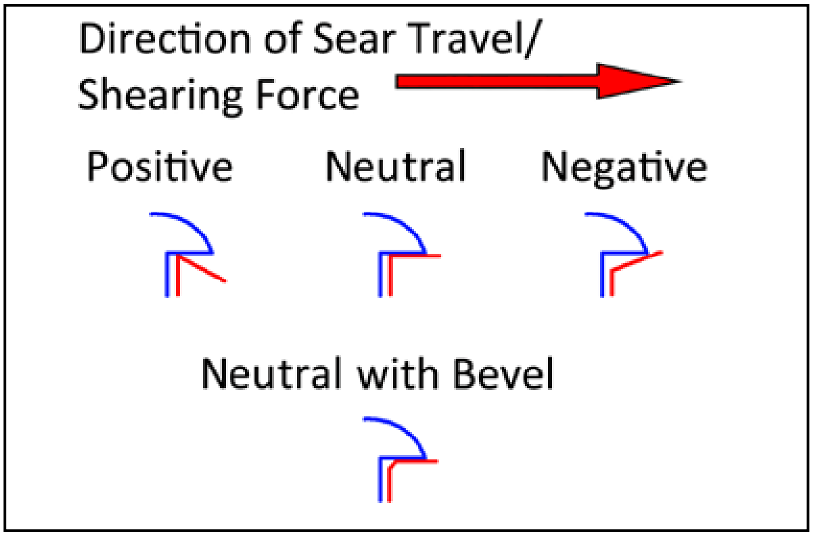

Figure 20: Sear engagement angles.

problem is addressed. This means the parts or assemblies must be cleaned, repaired, reprofiled or replaced. Do not move forward with any other function checks until the initial issues have been resolved. If the firearm has passed all of the initial checks, you can move forward with the next step.

Headspace

Headspace is one of the most critical dimensions of any firearm. In fact, headspace is so critical that +- .001 in. can be the difference between a firearm that is safe to fire and a firearm that is dangerous. Headspace represents the dimensions of the chamber, from breech face to the point in the chamber where the cartridge's case bottoms out. Each cartridge type will headspace against a different point of the case. The Sporting Arms and Ammunition Manufacturing Institute (SAAMI) closely regulates both chamber and ammunition specifications and dimensions, standardizing both across the industry.

Rimfire, rimmed centerfire, and shotgun cartridges all headspace against the rim of the case. Headspace for these cartridges is measured from the breech face to the top of the rim of the case. Centerfire pistol cartridges typically headspace against the leading edge of the mouth of the case. Centerfire pistol chamber headspace is measured from the breech face to the mouth of the case. Bottleneck centerfire rifle cartridges headspace against (roughly) the center of the case's shoulder, which is called the datum or datum line. Centerfire bottleneck chambers are measured from the breech face to the datum of the case's shoulder. Belted magnum centerfire rifle cartridges headspace against the top of the belt of the case. Belted magnum centerfire chambers are measured from the breech face to the top of the case's belt.

Headspace problems can lead to a variety of issues, ranging from feeding and locking malfunctions to a destroyed firearm and severe injury. Too little headspace (short chamber) and the cartridge may not fully seat, the breech may not lock, and if both occur, you may experience pressure spikes. Too much headspace (long chamber) and the case can expand beyond its capabilities and explode inside the chamber. There is an allowed tolerance for each cartridge type to operate safely within ranges from .005 in. to .010 in. This means that the chamber

Figure 21: Headspace point of each cartridge type.

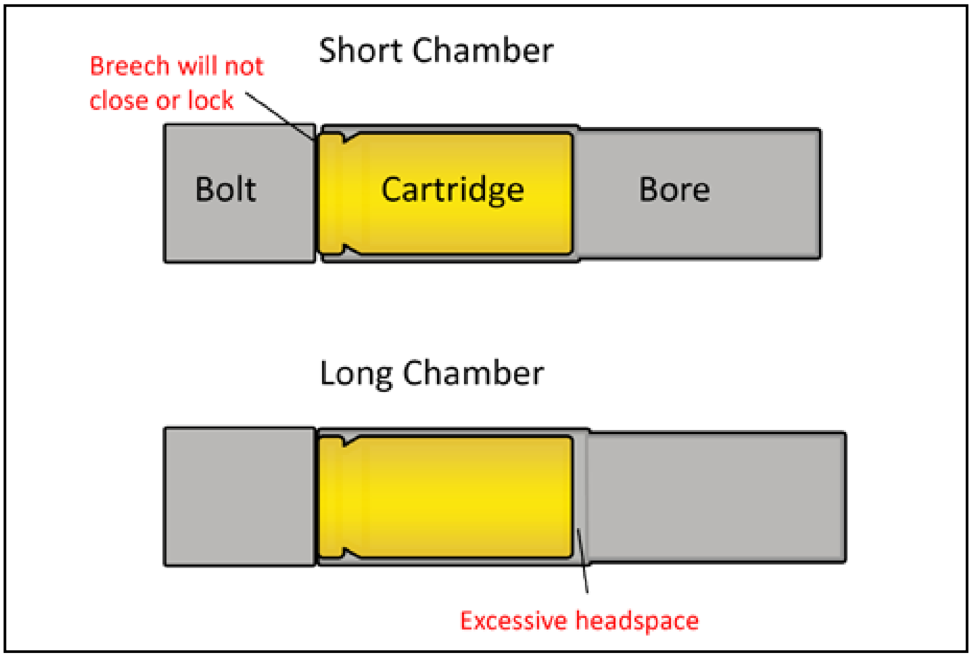

Figure 22: Headspace issues.

can vary in size from the absolute safest minimum to the absolute safest maximum ~.006 in., which is roughly the size of two pieces of paper. Headspace should be checked when performing a function and safety check on older, used, neglected, damaged, and malfunctioning firearms. Brand new, factory firearms will typically never need headspace checked, unless there is an issue.

Headspace can be easily measured using precision instruments called headspace gauges. Headspace gauges are precisely machined to represent the exact shape and dimensions of a properly machined chamber's headspace. Unlike snap caps and dummy rounds that are meant to simulate a live cartridge, headspace gauges may look like a partial representation of a cartridge. Headspace gauges are available for every SAAMI specs cartridge, as well as many wildcat cartridges.

Headspace gauges typically come in sets, with two to three gauges each. The sets typically contain Go, No-Go, and Field gauges. Go gauges represent the absolute minimum (shortest) size the chamber can be to safely and reliably operate. No-Go gauges represent a large (long) and possibly unsafe chamber, while Field gauges represent a chamber that is too long and very dangerous.

For example, a .223 Remington chamber is 1.4636 in. from breech/bolt face to datum and has a length tolerance of +.005 in. A .223 Remington Go gauge measures 1.4636 in. from base to datum, while a No-Go gauge will typically measure 1.4686 in. from base to datum. A .223 Remington Field gauge measures 1.4696 in. from base to datum, .001 in. greater than the allowable safe maximum. Headspace gauges can be found at various retailers, including Brownells.

Before you can use a headspace gauge, you must first remove the extractor and possibly the ejector*. If you try to use a headspace gauge with the extractor (and possibly ejector) installed, it could give a false reading as the gauge may be indicating off of the extractor (or ejector) instead of the breech/bolt/slide face. Once the extractor (and possibly ejector) are removed, you can feed the gauge into the chamber by hand. Slowly close the action on the gauge in the chamber.

**Only applicable to sprung ejectors, located in the breech/bolt face.*

Figure 23: Headspace gauges.

If you are using a Go gauge, the breech should close completely and lock on the gauge. If the action does not close completely or fully lock, this is an indication that the chamber may be too short, the breech/bolt may be out of spec, or the chamber/bolt/breech face is packed with debris and deposits of carbon and unburnt propellant. The action should not require a great amount of force to close either; the action should lock with light to moderate force. Do not try to force the action closed.

If you are using a No-Go gauge, the breech should not close completely or lock on the gauge, but there is a possibility that it might. If the action will not close or lock using a No-Go gauge and will close and lock using a Go gauge, your chamber is safe, within specification, and does not require further inspection. If the action closes and locks with ease on a No-Go gauge, there is definitely cause for concern and further inspection is required. If the action closes and locks, but requires a moderate amount of force to close, there may still be an issue and further inspection is required. Do not try to force the action closed.

If you are using a Field gauge, the breech must not close or lock on the gauge. If the action does close on the Field gauge, the headspace of the firearm is dangerously out of spec and requires immediate attention. The firearm is unsafe to fire and must be repaired before it can be used again. If the action will not close on a Field gauge, but will on a No-Go gauge, the firearm may still be safe to fire but will need to be test fired to verify.

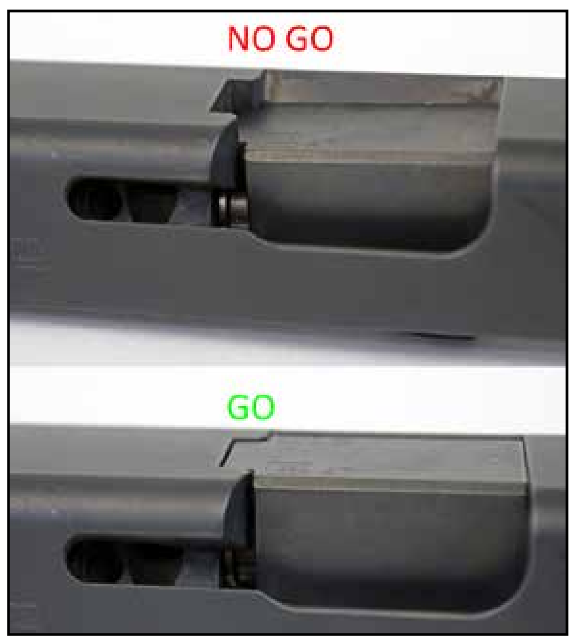

Figure 24: Using headspace gauges.

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Test Fire

Once you have completed the various function and safety checks and the firearm has been deemed safe, you may now perform a "live" test fire. Although the initial "dry" checks are required, the live fire test is the only definitive test of the firearm's function and safety. The live fire test will reveal any issues that the firearm may be experiencing as well as add additional factors as to why those problems are occurring. These additional factors include the action's function under operating conditions, the ammunition, and the operator.

These added factors may make diagnosing the firearm more difficult, especially when the first time you are experiencing them is during a client's description of the issue and their exact words are "*The thingy is jamming.*" Now you are left trying to recreate a malfunction that may not have ever been the firearm's fault. To efficiently and safely test fire any firearm, there are a few things that you must do to prepare.

Figure 26: A face shield, heavy duty gloves, and a thick apron.

The most important thing to consider when test firing is safety. Because the greatest risk for injury can occur during the test fire, all firearm safety rules apply. As long as all of the initial function and safety checks passed and the headspace check was within spec, the test fire should go smoothly and safely.

Extra precaution should be taken when test firing an unproven firearm. Outside of the eye and ear protection that you should already be using when shooting, a face shield, heavy duty gloves, and a thick apron can add a layer of protection

Figure 25: Test firing a semi-automatic pistol.

and a degree of confidence. These items will help to provide a bit of protection from shrapnel or burning propellant and hot gas. But if a firearm “grenades” during a test fire, some injury may still occur.

Figure 27: Examining the bore for obstructions.

One final check of the firearm should be performed before any test fire to ensure that it is properly lubricated and there are no obstructions in the bore. The action does not have to be cleaned, but there should be enough lubricant for the firearm to properly function and to avoid excessive parts wear. Verifying that the bore is clear of obstruction is extremely important. At this point, through all the previous checks, the firearm should have proven itself to be functional and safe. If a round was fired with an obstruction in the bore, the results would be catastrophic, both to the firearm and to the operator. A small flash light can be used to examine the bore, pointed from the muzzle and viewed through the chamber.

The ammunition used in the test fire is also a very important consideration. Because the ammunition itself can be a cause for malfunction, it is important to have multiple types of the same caliber ready for testing. Only use caliber-correct factory ammunition and avoid using hand loads and gun show reloads. If a client is reporting malfunctions with a specific type of ammunition, ask them to provide you with a box of rounds so that you can try to replicate the malfunction. Never use customer-supplied hand loads or loads you are unsure of when test firing.

One final consideration is your backstop or your bullet trap. You want to make sure you are test firing into a backstop or trap that will handle the caliber that you are test firing. You also want to make sure the backstop/trap can handle the rate of fire at which you may have to test the firearm. Some public ranges have restrictions on specific

Figure 28: Caliber-correct factory ammunition.

Figure 29: Appropriate backstops.

calibers and ammunition types or may not allow rapid fire. Many bullet traps have caliber restrictions and because of design constraints may be difficult or dangerous to try to rapid fire with. Public and private land (with permission) is more versatile and can often accommodate both your test fire and sight/optic zeroing needs.

Now that your safety gear, firearm, ammunition, and backstop are prepared, it is time to test fire. There are certain things you should be watching, feeling, and listening for while the firearm is discharging and cycling. This may be difficult at first, but over time, the more firearm types you test fire, the more you will be able to examine the firearm as it fires. The following is the sequence of events leading up to pressing the trigger:

- With the muzzle pointed at a backstop or inside a trap, insert only one cartridge into the chamber (single-shot) or feeding device (repeater). Do not use more than one round with repeating and semi-automatic firearms to lessen the risk of damage or injury if something goes wrong with the first round.
- With single-shot firearms, close and lock the action. With repeating firearms, cycle the action to feed the round. With semi-automatic firearms, verify that the action/

recoil spring has driven the action to feed and lock the round in the chamber.

- Establish an appropriate stance and grip. Secure handguns with both hands and rifles and shotguns with both hands and the shoulder.
- Deactivate the safety or set the selector to fire.
- Slowly and consistently press the trigger until the firearm fires.
- The firearm should have discharged, and the bullet should have completely exited the muzzle. With semi-automatic actions, the empty cartridge case should have been extracted and ejected several feet. Some semi-automatic actions may lock open automatically because the magazine is empty.
- With repeating manual actions, you will have to manually cycle the action to extract and eject the empty case. The case should come out easily with no resistance.

If you are test firing a single-shot firearm and the test fire was successful, you do not have to test the firearm any further. If you are test firing a repeating firearm, you will have to fire several more rounds. The next test will vary depending on action type, but will also mimic the first test. For double-barrel break-action firearms:

- Load a cartridge into both chambers and close and lock the action.
- Depending on action type, one of many things may happen. Some action types will allow you to simply deactivate the safety and fire two barrels with two separate triggers, in whatever order you choose. Other action types will utilize a double-set, single trigger that will fire both barrels (one at a time) by pressing the trigger twice. Depending on make and model, the sequence of the barrel's firing may be fixed or selectable. Regardless of action type, deactivate the safety.
- With double triggers, press one trigger at a time and fire both barrels. With

Figure 30: Test firing.

Figure 31: Test firing double-barrel break-action firearms.

double-set, single triggers, press the trigger to fire the first barrel. Allow the trigger to completely reset and fire the second barrel.

- Open the action. Both cases should lift simultaneously as the action pivots open, and with some actions, ejects automatically. If the cases do not eject automatically, extract the cases by hand. Both cases should come out easily with no resistance. If you are testing a double-set, single trigger action with a fixed firing sequence and the test fire was successful, you do not have to test the firearm any further. If you are testing a double trigger or double-set, single trigger action with a selectable firing sequence, you will need to perform this test once more, firing the barrels in the opposite order of the first test. If the test fire was successful, you do not have to test the firearm any further.

For repeating, manual action firearms:

- Load two rounds into the feeding device, fixed or removable.
- Manually cycle the action to feed the first cartridge.
- Press the trigger and fire the first cartridge.
- Release the trigger and manually cycle the action to extract and eject the first case and feed and chamber the second cartridge.
- Press the trigger once more and fire the second round.
- Release the trigger and manually cycle the action to extract and eject the second case. Both cartridges should have fired and both cases extracted and ejected with ease. If the feeding device is capable of holding more than two rounds, you will

have to test the firearm once more. Load the feeding device to capacity and perform the test once more. If the test fire was successful, you do not have to test the firearm any further.

For semi-automatic firearms:

- Load two rounds into the magazine and insert the magazine into the firearm.
- Cycle the action to chamber the first round.
- Press the trigger and fire the first round.
- The action should have automatically cycled, extracting and ejecting the empty case and feeding the second cartridge. Release the trigger and allow the FCG to reset. Check the action to verify that it locked on the second cartridge.
- Press the trigger and fire the second round.
- The action should have automatically cycled once more, extracting and ejecting the empty case and feeding the second cartridge. Release the trigger and allow the FCG to reset. Depending on the specific make and model, the action may be locked open. If the feeding device is capable of holding more than two rounds, you will have to test the firearm once more. Load the feeding device to capacity and perform the test once more. If the test fire was successful, you do not have to test the firearm any further.

Assuming all of the tests went smoothly and there were no malfunctions, the firearm does not need to be tested any further. If at any point in the test fire the firearm malfunctions, you will need to diagnose the problem.

Now that you understand how many different firearms are supposed to function, you can begin to troubleshoot what is happening when they malfunction.

Figure 32: Test firing semi-automatic firearms.

NOTES

NOTES

Chapter 2 - Troubleshooting Break- and Bolt-Action Firearms

Figure 1: Troubleshooting firearms.

Troubleshooting Firearms

Troubleshooting firearms can be a simple task or a frustrating endeavor, depending on the action type. There are three basic factors to consider when troubleshooting any firearm: the firearm, ammunition, and operator. Even the fired cases can provide evidence of what is happening inside the chamber.

If at any point during the previous test fire the firearm malfunctioned, there are several areas of the action to examine and questions you must ask yourself. The same questions apply to a

client-supplied firearm that they say is malfunctioning. These questions include, but are not limited to:

- What type of malfunction was it — failure to feed, fire, extract, eject?
- For failure to feed malfunctions, where did the cartridge become stuck? Was the round still in the feeding device, or wedged in the action or chamber? Did the round fail to seat completely or did the action fail to lock?
- For failure to fire malfunctions, is there an indentation on the primer? What type of ammunition are you using? Are you having the same issue with different types of ammunition?
- For failure to extract malfunctions, where is the empty case stuck? Did the case extract after a second or multiple attempts hand cycling the action? Does the rim of the case appear to be damaged, or does the body of the case look scratched or scored? What type of grip and stance are being employed?
- For failure to eject malfunctions, what type of grip and stance are being employed? What type of ammunition are you using? Are you having the same issue with different types of ammunition?

These questions are only the beginning of the troubleshooting process. If you are the one experiencing the malfunction or are present when the malfunction is happening, it is much easier to diagnose what is happening than to try to diagnose a client's firearm sight unseen. To properly troubleshoot a client's firearm, your best chance is to try to replicate the malfunction. This means they will need to provide you with some of the ammunition that the firearm is malfunctioning with, and possibly some of the fired cases. If the client is local, when they come to drop the firearm off, you can request that they demonstrate their grip and stance in front of you so that you can try to diagnose any operator error. This is not as easy if you are having the firearm shipped from out of state.

The first step in the troubleshooting process is to ensure the firearm is in proper working order and safe to fire once again. Because you may not have been present when the malfunction occurred or you are unsure of the condition of the parts after a malfunction, you should always do a quick safety and function check to avoid magnifying any issue. Verify that the bore is clear of any obstructions and that the action still moves smoothly and freely. Perform a quick inspection to verify that no parts are broken or damaged.

The next step is to try to recreate the malfunction. Using the same ammunition and trying to recreate the same conditions, did the same malfunction occur? Did a similar malfunction occur? If you are able to recreate the malfunction, then it will be easier to diagnose the problem. If you are not able to do so, the original malfunction may have been a fluke or may have been caused by operator error. With so many factors involved, at some point over time you are going to experience a malfunction that may only occur once with no explanation.

If you are able to recreate the malfunction, you can begin the troubleshooting process. To make the process simpler, you will need to eliminate as many factors as possible. The two factors that are the simplest to eliminate are ammunition and the operator.

AMMUNITION-INDUCED MALFUNCTIONS

If ammunition is suspected of causing a malfunction, the simplest way of rectifying this issue is to use a different brand or type of ammunition. If the malfunction is caused by a specific ammunition type, the malfunctions should cease when a different type of ammunition is used. If the issue persists, there is a possibility that the malfunctions are caused by the firearm or by the operator.

Figure 2: Hollow point feeding malfunction.

There are several reasons why ammunition would cause a malfunction. The first reason, which will lead to feeding malfunctions, is the shape of the bullet. While standard "ball" ammunition should feed through every action type, many will have trouble reliably feeding and cycling hollow points (Figure 2) and wadcutters. The issue occurs when the point (meplat) of the bullet catches an edge and comes to a halt. The leading edge of the mouth of the hollow point will typically catch on the leading edge of the throat of the chamber or the leading edge of the feed ramp.

Even some ball ammunition with certain ogive lengths and shapes (Figure 3) may create malfunctions with some firearms. As the ogive of the bullet slides up the feed ramp or the mouth of the barrel, its shape will drive the tip upward into the top of the chamber and cause the round to halt. The angle of the feed ramp/chamber mouth bevel and the shape of the ogive both contribute to fail to feed malfunctions and are fairly rare because of these factors.

Moving through the cycle of operations, ammunition can also be the cause of a failure to fire. There are two basic reasons why ammunition would fail to fire: improper storage and primer alloy. Ammunition needs to be stored in a cool, dry environment. Failure to properly store ammunition can lead to deterioration of both the propellant and priming compound. Either the primer will fail to ignite when struck by the firing pin/striker, or the propellant will fail to ignite when embers from the primer travel through the flash hole.

Improper storage can also lead to a dangerous situation known as a squib load. A squib occurs when only a portion of the propellant ignites, creating enough pressure to force the bullet from the case, but not enough to force it through the bore. The bullet becomes lodged in the bore. If a subsequent round were to be chambered and

Figure 3: Fail to feed malfunction caused by a unique ogive shape.

fired, the stuck bullet would act as a cork, blocking the bore and causing a huge pressure spike. The huge spike is enough to blow the action, chamber, and barrel apart and cause severe injury to the operator.

The second reason why ammunition may cause a failure to fire is the type of brass alloy used for the primer cup. Ammunition designed for military use typically utilizes a primer cup alloy that is harder than commercial ammunition. This is designed to prevent a condition known as a "slam fire." Many military firearms employ a "floating" firing pin, which means that it moves freely in its housing and is not restrained by a return spring. If soft primer ammunition is used in these firearms, there is a chance with the energy of the firing pin slamming forward that the round may fire. If hard primer ammunition is used in firearms designed for commercial ammo, like a 7.62x51 NATO round in a .308 Winchester chamber, there is a potential for a "light strike." A light strike occurs when the firing pin or striker does not have enough energy to ignite the priming compound.

Ammunition can also cause both failures to extract and eject. These malfunctions can be caused by the cartridge case's material, coating, or the load of the round itself. Starting with failures to extract, both the case material and its (possible) coating can contribute to these types of malfunctions. While a standard brass case will expand and contract when fired, allowing for easy extraction, cases made from steel will not always contract to their original size. The increased friction from the swollen case against the chamber walls will place more tension on the extractor than it can handle. When the extractor tries to pull against the case head, the

Figure 4: Military vs. commercial ammunition.

friction on the case will overcome the power of the extractor and the extractor's claw will slip over the rim.

Case coatings can also lead to the same type of failure to extract malfunctions. Typically, steel case ammunition is coated with either lacquer or polymer. During rapid fire strings, the heat inside the chamber is great enough to soften and melt the case coating. With enough rounds fired, the coating will begin to "gum up" the chamber and cases will begin to stick. If left untreated, even brass cases will begin to stick to the lacquer or polymer remnants inside the chamber.

With semi-automatic firearms, the specific "load" of the cartridge can cause both failure to extract and eject malfunctions. Because the function of semi-automatic firearms is reliant on the pressure generated by the cartridge, rounds that are underpowered may not fully cycle the action. Ammunition designed for self-defense or marketed as "low recoil" target ammunition, or ammunition that was improperly stored, may all fail to generate enough energy to fully cycle the action and cause either a failure to extract or a failure to eject. The round may even generate enough energy to extract and eject the empty case, but not to feed or fully chamber the next round. This condition is known as "short-stroking."

Figure 5: Steel-cased, lacquer-coated ammunition.

OPERATOR-INDUCED MALFUNCTIONS

Once you have ruled out ammunition as a possible cause of malfunction, the next factor that can be easily ruled out is operator error. Operator-induced malfunctions can typically be ruled out during the initial test fire. Semi-automatic firearms are the most susceptible to operator error, with semi-automatic pistols topping the list. Certain manual actions, such as lever- or pump-actions, can also be affected by improper technique.

Operator error can lead to failures to feed, extract, and eject. Most operator error is caused by short-stroking the action due to a condition known as "limp wristing." Limp wristing is a term that describes an improper shooting technique where the (semi-automatic) firearm

Figure 6: Limp wristing.

is not secured while being discharged. The energy used to cycle the action is transferred to the whole firearm as it recoils rearward and dissipates. This causes the action to short-stroke. With manual repeating actions, the malfunction is created when the operator manually short-strokes the action. Operator error can easily be averted by securing the firearm and utilizing proper shooting technique.

There are many other types of shooter-induced stoppages that you may find on a case-by-case basis. These malfunctions can be attributed to inexperience and can be resolved with proper technique. The malfunctions include but are not limited to:

- **Failure to Disengage the Safety –** Failure to disengage the safety will lead to a (perceived) failure to fire. Depending on the action type, the trigger may be blocked and not move, or move with a "dead" feeling.
- **Failure to Seat the Magazine –** Failure to fully seat a magazine will lead to a (perceived) failure to fire, but the chamber is actually empty. If the magazine is not fully seated, when the action is cycled the bolt/slide will simply pass over the top round and fail to feed. The magazine may even fall from the action when it is cycled. When fully seated, the magazine should "click" into place. Sometimes, when a magazine is loaded to its maximum capacity, it will not seat when the bolt or slide is closed. You may have to download the magazine one to two rounds so that the magazine will fully seat.
- **Depressing the Magazine Release While Firing –** Depressing the magazine release while firing will lead to a (perceived) failure to fire, but the chamber is actually empty. This issue is caused by an improper grip. When the operator places his/her hands on the firearm, an improper grip can lead to part of the hand contacting the magazine release under recoil. This would cause the magazine to drop slightly and the bolt/slide to pass over the next round. Simply changing the shooting grip will resolve this issue.

- **Engaging the Bolt/Slide Stop While Firing –** Engaging the bolt/slide stop while firing will lead to a (perceived) empty magazine. Like the previous malfunction, this malfunction is caused by improper grip. When the operator places his/her hands on the firearm, an improper grip can lead to part of the hand contacting the bolt/slide stop under recoil. This would cause the bolt/slide to lock open as if the magazine were empty. Simply changing the shooting grip will resolve this issue.

- **Short-Stroking the Trigger –** Short-stroking the trigger will lead to a (perceived) failure to fire. If the trigger is not allowed to fully reset, it may feel "dead" or light when pressed again. Simply allowing the trigger to return to its resting position until you can feel or hear (or both) the trigger reset will resolve this issue.

Now that you have ruled out ammunition and operator error as possible causes of malfunction, you can focus on the firearm. Each action type will require understanding of the functions of operations for each type to be able to effectively troubleshoot. Each action type will feature unique factors as to why a specific malfunction occurred. The following is a detailed overview of the causes for various malfunctions in different action types.

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Troubleshooting Break- and Bolt-Actions

Of all of the action types, including many of the manual actions, the break- and bolt-actions are some of the simplest designs. With less moving parts, the chances of malfunction are reduced, which also means there are less parts to diagnose. As long as you have a basic understanding of how these actions operate, troubleshooting should be straightforward.

BREAK-ACTION FIREARMS

Of the two action types (break and bolt), the break-action is probably one of the simplest designs. In fact, several of the steps of the cycle of operations are not performed by the action; they are performed manually by the operator. Typically, the break-style action will only fire and partially extract, while some actions may even eject. This makes diagnosing these action types fairly simple.

Figure 7: Leading edge of a break-action chamber.

Break-Action Feeding Problems

We will begin with failure to feed malfunctions. Because the feeding step is controlled entirely by the operator, there are only a few things that can cause a feeding malfunction with break-action firearms. Starting with the mouth of the chamber, if there are any burrs or the mouth was not properly chamfered/beveled, the round can snag or become stuck against the inside leading edge of the chamber. You may notice scoring along the side of the case (or snap cap) from the burrs on the chamber mouth.

The next possible cause for a feeding malfunction in a break-action firearm would be dirt and debris. Neglecting basic cleaning and maintenance can lead to a situation where excessive dirt and debris buildup inside the chamber can create a failure to feed malfunction. Firearms that are stored with excessive oil can also lead to malfunctions. Over time, the oil in the chamber will begin to gum up and become sticky, making loading difficult. Using more oil to try to remedy the issue will only compound the problem. The oil will attract more dirt and debris and will eventually become mud-like and eventually harden.

The least likely cause (but still a possibility) is a roughly machined chamber. If the tooling used to cut the chamber is old or dull, or is not moving at the correct speed, it will leave the surface finish of the chamber "chattered" or rough. The machining in the chamber would have to be very rough, featuring scratches and scoring before it could create a failure to feed, but it is possible. An undersized or out-of-spec chamber can also lead to a feeding malfunction.

Repairing most of these issues is straightforward. If the mouth of the chamber is burred or the leading edge has not been beveled or chamfered, you will need to clean up the edge. This can be easily accomplished with some needle

Figure 8: Cutting the chamfer with a half-round file.

or diamond files and several different grits of sandpaper. If the edge is just burred, you must simply remove the burr with a small file until all the burrs are gone. Make certain you follow the shape of the current bevel or chamfer. Once the burr has been removed, lightly sand the area with 150-, 220-, and 320-grit sandpaper, respectively, to smooth out any file marks.

If the mouth of the chamber was not chamfered, you will need to profile the inside edge. Using a half-round needle file, bevel the inside edge of the mouth of the chamber. Cut the chamfer at (or near) a 45° angle, roughly .020 in. – .030 in. deep. The angle and size do not have to be exact as long as the end result produces smooth feeding. Once the chamfer has been cut using files, clean the file marks up with 150-, 220-, 320-, and 400-grit sandpaper, respectively.

Fixing feeding malfunctions caused by a dirty chamber is as simple as cleaning the chamber. Using a brass chamber brush and a quality cleaning solvent, thoroughly scrub the chamber until it is clean. You may have to use specialized cleaners designed to remove carbon, copper, and lead fouling if the firearm has been heavily used while maintenance has been neglected. You may have to perform several cycles of scrubbing with the brush and applying cleaner before the chamber is completely clean. Once the chamber is clean, apply a light coating of a quality firearm lubricant. Do not apply the lubricant too heavily as it will lead to the same problem. Regular maintenance will prevent these issues from returning.

If the chamber is rough or undersized, the fix is a bit more difficult. Starting with a rough chamber, the scratches, scoring, and some of the chatter can be polished out. If you have access to a lathe and are able to remove the barrel from the action, you can repair the chamber with a marginal amount of effort. Once you have the barrel aligned and secured in the chuck of the lathe, you can use a wooden dowel (with a smaller diameter than the chamber) and a piece of sandpaper to polish out the scratches or chatter. Using 400-grit sandpaper wrapped around the dowel, apply light pressure to the wall of the chamber while the barrel spins. You only want to remove the scratches and (some) of the chatter, as removing too much material can lead to an oversized chamber that is dangerous. Lightly sand the chamber with 400-grit until the scratches are gone and finish the chamber with 800-grit sandpaper to apply a quick polish. Remove the barrel from the lathe and thoroughly clean and lightly lubricate the chamber. Re-install the barrel and test fire the firearm to verify function.

If you do not have access to a lathe, or you are not able to remove the barrel from the action, there is another option. Brownells offers an alternative in the form of their Flex-Hone® line of products, designed to polish a chamber while the barrel is installed in the action. The Flex-Hone tool features a head that is roughly the same size and shape (or slightly oversized) as the chamber, made up of small abrasive (silicon carbide) balls that are used to polish. The head is attached to a long shaft that is attached to and driven by a hand drill. You must use only Flex-Hone oil when using the Flex-Hone tool system to polish the chamber. The Flex-Hone tools typically come in both 400- and 800-grits.

Figure 9: Repairing a rough chamber in a lathe.

With the Flex-Hone tool (Figure 10) attached to the hand drill, apply the Flex-Hone oil to both the Flex-Hone tool and the chamber. Using medium speed and light pressure, polish the chamber, starting with the 400-grit first. You only want to remove the scratches and (some) of the chatter, as removing too much material can lead to an oversized chamber that is dangerous. Follow the 400-grit with the 800-grit Flex-Hone tool and finish by thoroughly cleaning the chamber and bore and lightly oiling both with a quality firearm lubricant. Once everything is clean and oiled, you can reassemble the firearm and test fire it. If the issue persists after polishing the chamber, you may need to rebarrel the firearm. Increasing the dimensions of the chamber too far can create a very dangerous (headspace) issue.

Figure 10: Brownells Flex-Hone tool. Image courtesy of Brownells.

If the feed issue is a result of a "short" chamber, you will need to recut the chamber until it is within specification. This can be accomplished on a lathe or by hand; either way, the barrel(s) needs to be removed from the action. Using a specialized chamber reamer, called a finish reamer, cut the chamber to length. Finish reamers are produced for use by both lathe and hand. Reamers intended for hand use typically feature an integral pilot used to keep the reamer centered in the chamber. Reamers intended for lathe use do not typically feature this pilot as the

alignment of the cutter and chamber is accomplished through adjustments on the machine. Whichever method you employ, make certain to use plenty of cutting oil and move slowly. Depending on how far you need to cut the chamber, remove only a few thousandths (.001 in. – .005 in.) of material at a time. Check the chamber with a Go gauge often until the chamber is cut to full depth. Do not cut the chamber too long as it will lead to a very dangerous headspace issue. Once the chamber is cut to length, reinstall the barrel(s) back in the action, check headspace, and test fire the firearm.

Break-Action Locking Problems

Moving through the cycle of operations, the next types of malfunctions you may experience would occur during the locking step. The lock-up of the barrel(s) and receiver is critical to the proper function of the firearm and the safety of the operator. When the breech of a break-action firearm is locked, locking lugs on the barrel have engaged locking lugs on the receiver and the two parts are secured by the top lever assembly or the crossbolt. Depending on design, the breech will either lock when the locking lugs located in the receiver are secured by the top lever, or when the crossbolt engages the cutout in the barrel's locking lug. When the top lever is manipulated and the breech is unlocked, the locking lugs in the receiver will disengage the lugs on the barrel(s) and allow the barrel to pivot down and expose the chambers.

Much of the physical process of locking is controlled by the top lever or crossbolt, while the locking lugs secure the chamber during discharge. If the top lever assembly/crossbolt is damaged or broken, there is a possibility that the breech can unlock and open during firing, which can lead to damage to the firearm and injury to the operator. Although the breech coming unlocked during discharge is fairly uncommon, broken parts, damage, and excessive wear can all lead to a locking/unlocking malfunction.

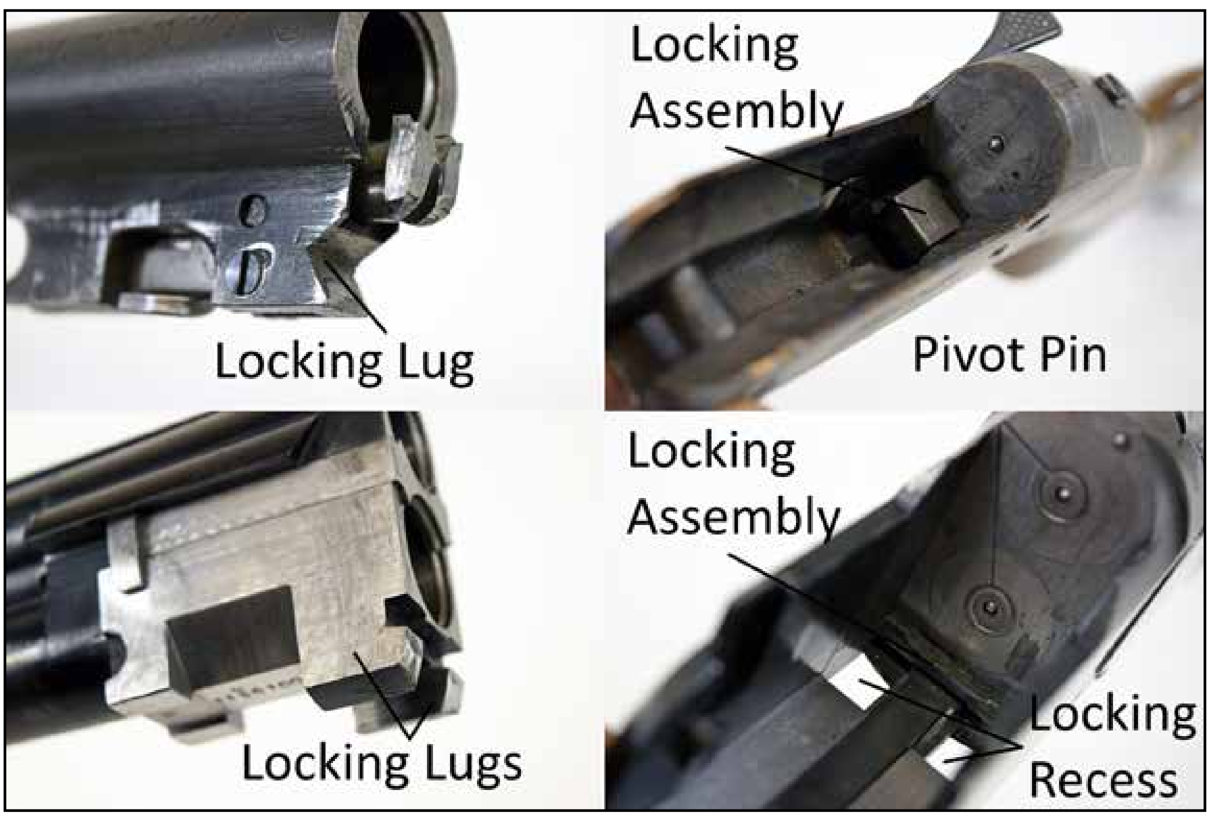

Figure 11: Locking surfaces of break-action firearms.

Figure 12: Peening the locking lugs and hinge pin recess.

Excessive wear of the locking lugs and hinge can also create an excessive amount of "play" between the receiver and barrel(s), which can lead to a dangerous situation.

Repairing locking issues is fairly straightforward, depending on the cause of the malfunction. If the action fails to lock because of dings or burrs on the locking surfaces, you can remove and repair the parts by filing the burrs off or by filing down the raised portion of the ding until it is flush with the surface. Once the burr or ding is removed, clean up the file marks with sandpaper in 150-, 220- and 320-grits. Be cautious not to remove any more material than necessary.

If the lugs on the barrel are damaged or broken or if any of the parts of the locking assembly located in the receiver are damaged or broken, you will have to replace these parts. You can typically find factory replacement, new aftermarket, or slightly used parts to replace the broken or damaged ones. Once the part(s) has been replaced, perform a function and safety check to verify the function of the firearm.

If the action is "loose," you can replace the hinge pin or peen the locking surface to remove some play. Peening is a process of working metal with the domed end of a ball-peen hammer. Peening is used to remove metal, as well as harden the surface of a part, like with shot peening. Peening with a ball-peen hammer will leave small dish-shaped indentations on the metal's surface, while the material around the dish will be forced outward.

Peening the locking and pivot surfaces of a break-action barrel will force material into areas where material has been worn down, restoring some of the tolerance lost. Peening can help to alleviate both vertical and horizontal play. Vertical play is typically controlled by peening the locking lugs, while horizontal play is controlled by peening the pivot pin recess surfaces.

Peening can be accomplished with a ball-peen hammer or with modified center punches. You will also need a flat metal backing to perform the peening against because wood and plastic have too much "give" and will absorb impact instead

of transferring it. Place the barrel(s) on the metal backing so that only the lugs and pivot recess are supported and nothing is touching the barrels. If the barrels are not allowed to float, there is a chance they can be damaged when peening the lugs. Make sure the barrels are stable and secure before beginning.

To begin, you will want to remove the fore and aft play, which is controlled by the recess for the hinge pin. You will want to peen the semicircular recess around its circumference, about 1⁄16 in. to 3⁄32 in. from the edge. Do not peen the edge of the recess to prevent damage or chipping the edge. Begin in the center of the arc and peen outward along the radius. Do not peen the entire radius; rather, peen a small section in the center and turn the barrels over to perform the same exact peening on the opposite side. Make sure both sides are even. Reinstall the barrels and test the fit. Often, peening the pivot pin recess will remove both horizontal and vertical play.

If there is still some vertical play, you will need to peen the locking lug(s). You will need to peen the lug(s) in such a way that the redistributed material forces the barrels downward. Typically, this involves peening the lug along its inside top edge. This will force material upward and the barrels downward during lockup. Make sure to peen both sides of the lug(s) evenly and spaced at least 1⁄8 in. from the edge. Begin from the inside corner of the lug(s) and work outward toward the edge. Peen a small area and reinstall the barrel(s) to check fitment. If the lugs are too tight or the pivot recess is too tight, you can remove a small amount of material with a file and clean up file marks with sandpaper.

Break-Action Cocking Problems

Continuing through the cycle of operations, the next type of malfunction you may experience would occur during the cocking step. Failures to cock occur when the hammer/striker(s) fails

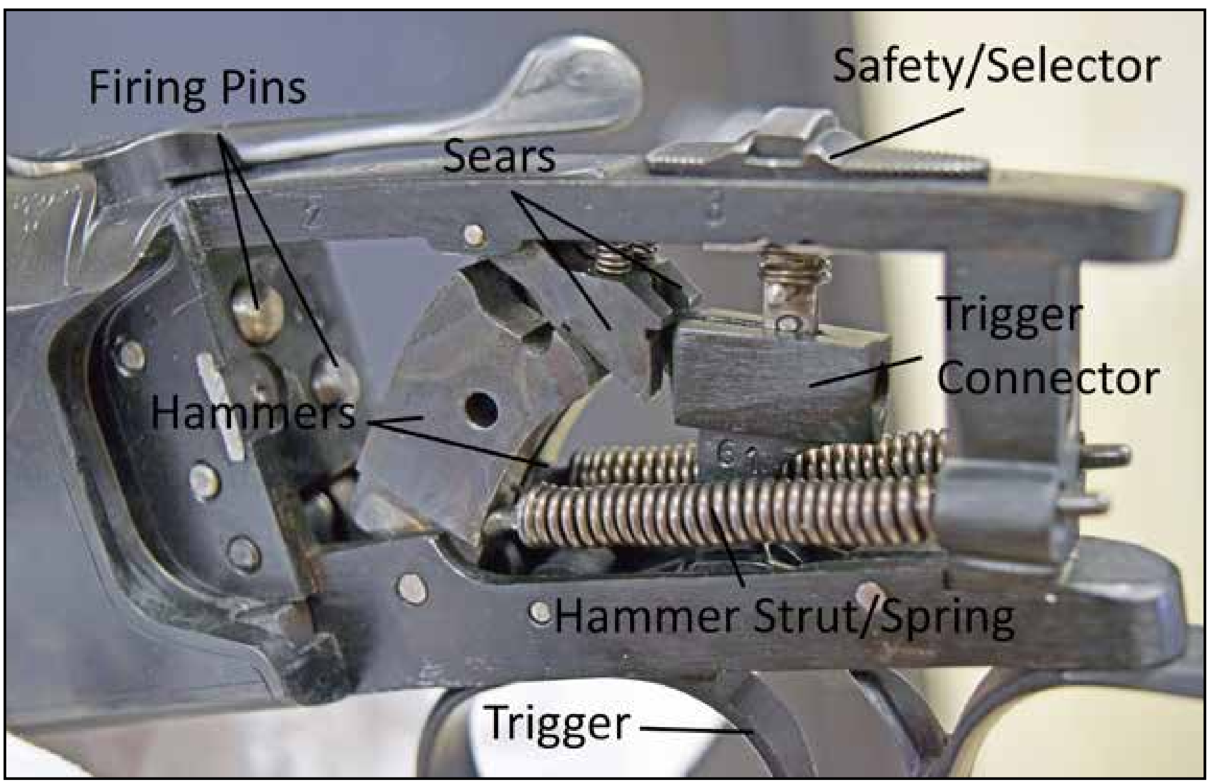

Figure 13: Break-action sear/hammer engagement assembly.

to engage the cocked position. Depending on the specific model, the hammer(s)/striker(s) is cocked by a cocking bar/lever (which automatically sets the safety) or manually by the operator once the breech has been locked. Failure to cock malfunctions can render the firearm inoperable and (depending on cause) can lead to a dangerous situation known as hammer follow. Hammer follow occurs when the hammer/striker fails to engage the sear surface that holds it in the cocked position. This allows the hammer to fall prematurely and possibly cause an accidental discharge.

Failure to cock malfunctions are typically caused by a damaged or worn cocking bar/lever(s) and its assemblies or incorrectly shaped sear surfaces. They can also be caused by worn or damaged springs. If the cocking bar/lever is damaged or broken, it will fail to push the hammer/striker(s) back far enough to fully engage the cocking sears. If the sear surface (either on the hammer/striker or sear assembly) is damaged, rounded or worn, the hammer/striker may slightly engage the sear and slip off or push the sear out of the way. If the springs are worn or damaged, they may fail to push the sear assembly into the hammer/striker's path and allow the hammer to fall. A damaged or broken hammer strut can also prevent the hammers from traveling backward far enough to fully engage the sear(s). Excessive dirt and debris can also cause these assemblies to malfunction.

Repairing failure to cock malfunctions is as simple as replacing the worn or damaged parts. This means the cocking bar/lever and assembly or the FCG assembly. Typically, you will want to replace both hammer/striker and sear assemblies as well as springs to completely "refresh" the FCG. You can replace the worn or damaged parts, but you will be ensuring that sometime in the near future you will be replacing additional parts. Often, then-new parts will put strain against the old parts and cause them to expire prematurely.

Occasionally, new or replacement parts are not available, but sometimes worn sear surfaces can be saved by simply "dressing" or slightly reshaping the existing parts. If the sear(s) is rounded or set at a negative angle, it can sometimes be shaped using various grits of stone files. Refer to the drawing on page 22 (Figure 20) of correct and incorrect sear angles previously in this guide. This process is often tedious and very slow because you must remove the part(s), lightly shape the sear faces, reinstall the parts, and function check the assembly. The process is repeated several times until the function is correct.

Use a magnifying tool (preferably a magnified lamp) to examine the sear engagement angles while the parts are installed, if possible. If not, use marking fluid or a Sharpie® to reveal where the surfaces are contacting. Pay special attention to the relationship of the sear angle to the direction of travel of the assemblies, as the sear surfaces shear across each other. Even if the sear surfaces are set at a positive or neutral angle to each other, they may be set at an incorrect angle in relation to their travel.

Figure 14: Stoning sear surfaces.

Lightly stone the sear surface(s) with an India stone (roughest) to shape the facets until they are the correct angle in relation to their travel. Move slowly and be cautious not to remove too much material at a time. With only a few strokes of the stone file, reapply marking fluid and reinstall and function check the assembly. Make sure to hold the stone steadily, at the correct angle for each stroke. Do not wobble or vary in your form as you shape the sear faces. Once the facets are shaped, you can clean the file marks up with a black or white ceramic stone file. Clean and reinstall the parts and perform a function and safety check. Reassemble the firearm and test fire. If everything performs as it should, you are done. If not, you will need to repeat the process. Please note that you can only file sear surfaces so far before you start to affect their safe function. Use your experience (and discretion) to realize when a part cannot be saved and another option must be utilized.

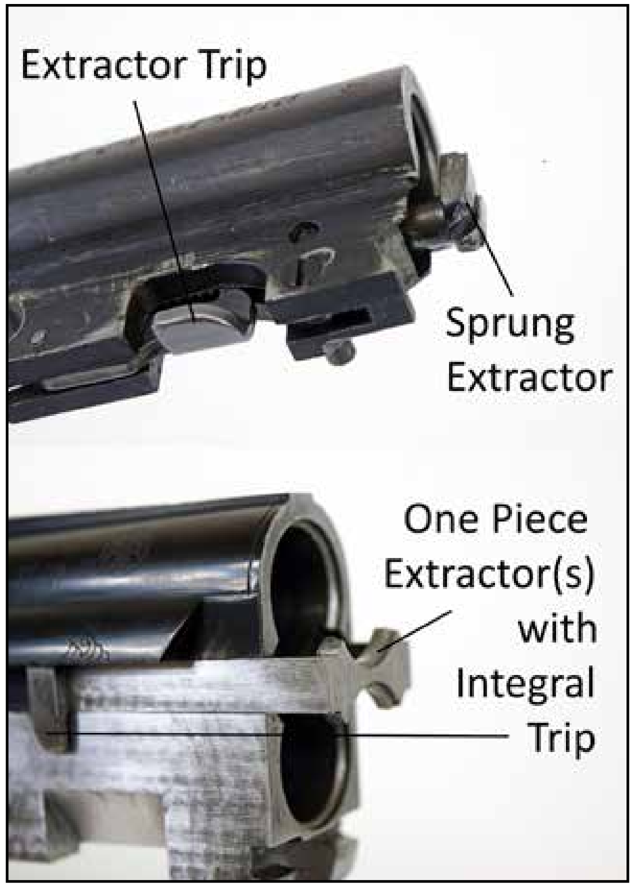

Figure 15: Parts of a break-action extractor.

Break-Action Failure to Fire

The next types of malfunctions you may experience would be failures to fire (FTF). Failures to fire occur when the firearm's FCG fails to generate enough energy to ignite the cartridge's primer. With break-actions, this can be caused by several parts of the FCG. Depending on the specific model, a failure to fire can be caused by the hammer(s), striker(s), fining pin(s), transfer bars, selectors, or springs. Any of these parts can contribute to a condition known as a "light strike." A light strike occurs when the primer is impacted but not ignited. Often, there is a small indentation on the primer cup.

Damage, wear, dirt, and debris, and parts breakage can all lead to failure to fire malfunctions. Often the leading cause of FTF malfunctions is worn springs that fail to drive the firing pin/striker fast enough to generate the required amount of energy needed to properly crush the primer cup. FCG springs will typically wear faster than other firearm springs because they are under strain even when the firearm is not being discharged, like with function checks and dry fire practice. Excessive dirt and debris can also slow parts of the FCG down enough to limit their potential energy.

If a failure to fire malfunction occurs and there is no mark on the primer cup, there is a high possibility that the tip of the firing pin/striker is broken. The firing pin or striker may be broken farther down the part's body, or other parts may be broken, like the hammer or transfer bar (which transfers energy from the hammer(s) to floating firing pin(s)). These parts may become wedged in the FCG or in other parts of the action.

Repairing failure to fire malfunctions is as simple as cleaning the FCG or replacing the worn or damaged parts. This means the hammer(s), striker(s), firing pin(s), the transfer bar and

springs. Typically, you will want to replace both hammer/striker and sear assemblies as well as springs to completely "refresh" the FCG. You can replace the worn or damaged parts, but you will be ensuring that sometime in the near future you will be replacing additional parts. Often, then-new parts will put strain against the old parts and cause them to expire prematurely.

Unlocking Problems

Moving through the cycle of operations (COO), the next types of malfunctions that may occur would be during the unlocking step. Although this scenario is uncommon, there is a possibility that parts of the action that control locking can break and cause the action to remain locked. The top lever and locking assemblies inside the receiver can both cause this type of malfunction if they were to break inside the action.

Repairing unlocking issues is as simple as replacing the broken parts. The most difficult aspect of the repair is that you will not be able to field strip the firearm, which means you will have to work with the barrels still attached. Once you disassemble most of the action and remove the broken assemblies, you will be able to unlock the action once again. Once the action is open and the broken parts have been replaced, you can reassemble the firearm normally and test function.

Break-Action Extracting Problems

Continuing through the COO, the next types of malfunctions you may experience are failures to extract. A failure to extract occurs when the action pivots open and the empty case(s) remains in the chamber. Both the extractor(s) and the assemblies and the chamber can contribute to failure to extract malfunctions in break-actions. When the action is opened, a bar/lever located in the barrel(s) acts against a lug/protrusion on the receiver, which drives the extractor(s) outward, forcing the cases from the chamber.

When a failure to extract malfunction occurs, either the extractor (or its assembly) has failed or the chamber is excessively dirty or rough. If the extractor or its assembly is broken, damaged

Figure 16: Auto-ejecting break-action shotgun.

Figure 17: Single-shot, fixed, and detachable box magazine bolt-actions.

or worn, the extractor will not drive the case or will slip over the case rim. If the chamber is excessively dirty or rough, the case will stick to the chamber and cause the extractor to jump over the case rim.

If the failure to extract is caused by the extractor or its assembly, you can simply replace the damaged or worn parts to remedy the issue. If the failure to extract is caused by a rough chamber, the fix is a bit more involved. Repairing a rough chamber can be accomplished on a lathe with sandpaper and a dowel, or with Brownells Flex-Hone line of products.

Failure to Eject Problems

The final types of malfunctions you may encounter with break-action firearms are failures to extract. Typically, break-action firearms do not automatically eject empty cases like other action designs, but some “high-end” break-action firearms feature a type of auto-eject feature. The auto-eject feature utilizes a spring-loaded extractor that also acts as an ejector. When the action is opened and begins to pivot, the extractor/ejector will begin to extract the spent cases from the chamber. When the action reaches a certain point in its travel, the spring driving the extractor/ejector will release its energy, driving the ejector outward and sending the empty cases flying.

Failure to eject malfunctions occur when any part of the auto-eject assembly becomes worn, damaged, or broken. When these parts or assemblies fail, the empty cases will remain in the chamber. Although this is not a big deal with the break-action design, the firearm is still malfunctioning because it is not operating normally. The empty cases can still be removed from the chambers by hand, like with other break-action designs.

Repairing failure to eject malfunctions with certain break-action firearms is as simple as replacing broken, damaged, or worn parts. This includes the extractor/ejector, its assembly, including tripping mechanism, and spring. Once the assemblies are replaced, function check and test fire the firearm.

Bolt-Action Firearms

Like break-action firearms, bolt-action firearms are also very simple machines. Depending on the specific model of bolt-action firearm, some of the steps of the COO are not even controlled by the firearm. Bolt-action firearms are available in both single-shot and repeating actions. The addition of a feeding device will add a new factor to diagnosing certain bolt-action firearms.

We will begin with failure to feed malfunctions. The cause of the failure to feed will depend on the specific action types, which are divided into single-shot and repeating firearms. Repeating bolt-actions are even divided into fixed (internal blind box) and detachable magazine types and by the actual feed process, controlled or push feed. Each type will feature unique factors that can contribute to fail to feed malfunctions.

Single-Shot Bolt-Action Feeding Problems

Starting with single-shot, bolt-action firearms, diagnosing feeding issues is fairly simple because half of the feeding process is accomplished by the operator, by hand. Once the operator inserts a cartridge into the breech, he/she must manipulate the bolt forward (feeding the cartridge into the chamber) and down (locking the chamber). This limits the number of assemblies and parts that can affect the feeding step in the cycle of operations. The part that affects the reliability of the feeding process is the breech end of the barrel, more specifically the mouth of the chamber.

The bevel or chamfer on the leading edge of the mouth of the chamber makes the cartridge's transition into the chamber. If there is no bevel or chamfer present, it is extremely likely that the point or nose (meplat) of the bullet will catch the leading edge of the chamber and jam in the action. A roughly machined, short, or excessively dirty chamber can also cause feeding issues. One other possible cause could come from a worn or damaged bolt face that pushes the cartridge off-center and cants it enough to cause a malfunction.

Repairing feeding issues with single-shot bolt-action firearms is fairly straightforward. If the issue is caused by a lack of bevel/chamfer, you will need to form a bevel on the chamber's mouth. The process is simplified if you have the tools and experience to remove the barrel from the action. If not, you will have to cut the chamfer in with the barrel installed in the receiver. If the issue is caused by a short or rough chamber, you will need to polish or recut the chamber to SAAMI specs. If the bolt face is damaged or worn, you will need to replace the bolt/bolt head. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate the chamber.

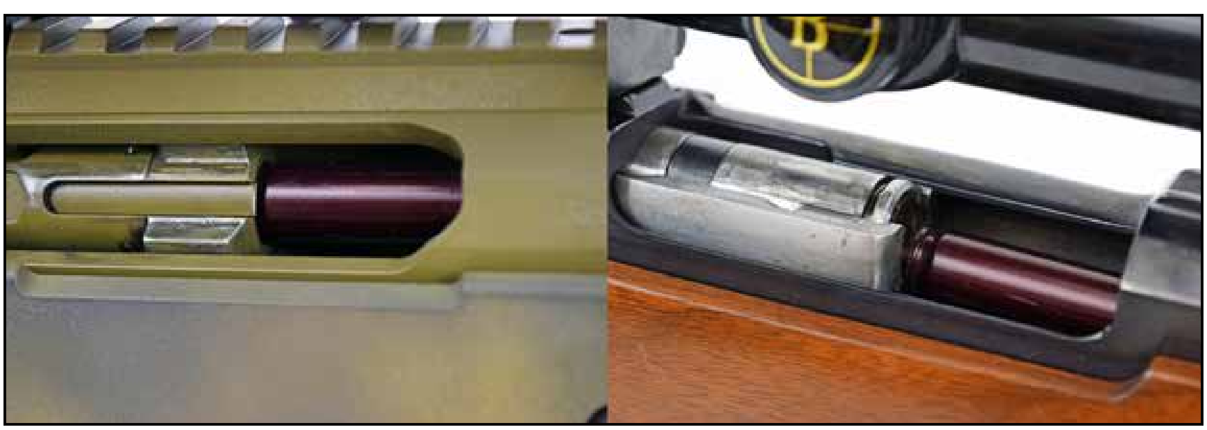

Figure 18: Controlled vs. push feed systems.

Repeating Bolt-Action Feeding Problems

Moving on to repeating bolt-action firearms, diagnosing feeding issues can be a bit more challenging with the added factor of the magazine assembly. To make things even more challenging, you must understand the two different methods of feeding in certain bolt-action designs: controlled and push feed. Additional parts such as magazine catch/releases and magazine cutoffs can also make diagnosing feeding issues in these firearms more difficult.

We will begin with internal (blind) box magazine-fed bolt-action firearms. Internal box-fed, magazine-fed bolt-action firearms feature an integral box magazine that is concealed within the stock of the firearm, which is why it is often referred to as a "blind box" or blind magazine. The magazine consists of a body (which may be integral to the receiver), follower, spring and (sometimes) a hinged floor plate. Internal box magazines can be found in both single- and double-stack applications and in single- and double-feed designs. The internal box magazine is loaded by the operator, through the ejection port, and can typically hold between two and five cartridges. The feed lips of the magazine (either integral to the magazine body or underside of the receiver) hold the cartridges in the magazine and align them with the chamber. The spring forces the follower upward, which supports and drives the new cartridges in preparation for feeding. The hinged floor plate allows access to the magazine for maintenance or repair and cannot be used for loading.

When the magazine has been loaded, the operator can manipulate the bolt and begin to feed the first round from the magazine. As the operator drives the bolt forward, a lug or protrusion on the underside of the bolt contacts the head of the cartridge case and begins to push the cartridge from the feed lip(s) of the magazine. This is where certain feed design types differ.

With a controlled feed design, once the bolt has pushed the cartridge clear of the feed lips, the head of the cartridge will move upward so that the extractor hook slides into the extractor groove on the case head. The cartridge will center itself on the bolt face, while the case is supported and aligned by the bolt. The bolt head will continue to support the case head as the round is fed, seated, and locked into the chamber.

Figure 19: Bolt-action magazine catch.

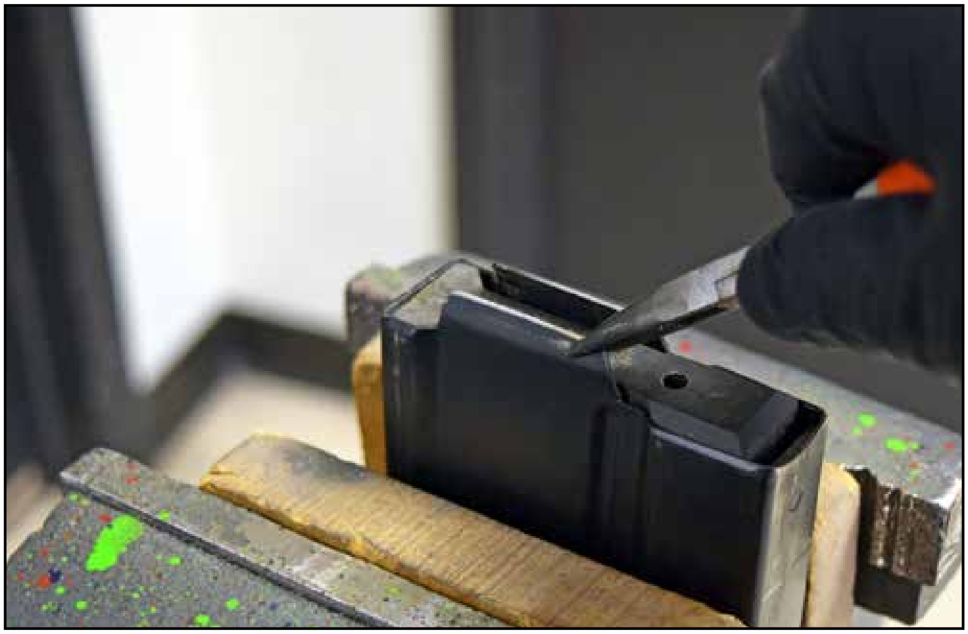

Figure 20: Adjusting the feed lips to control feeding.

With a push feed design, once the bolt has pushed the cartridge clear of the feed lips, the cartridge will continue forward, being driven by the bolt face and leading face of the extractor. The bolt and extractor will continue to drive the round forward until it feeds into the chamber and completely seats. Once the round is completely seated in the chamber, the extractor will move over the rim of the case and into the extractor groove as the bolt continues forward and locks.

Any one of these assemblies can contribute to a failure to feed malfunction, as well as other factors like a dirty, rough, or undersized chamber. There are some internal box magazine designs that utilize a component called a magazine cutoff or cartridge stop. The cutoff allows the operator to block off the cartridges in the magazine and prevent them from feeding. This design allows the operator to change ammunition types without unloading the magazine. This design also allows some military bolt-action rifles to fire grenades with an adapter and blanks.

If the magazine spring is worn or broken, it will fail to force the follower and rounds upward into the path of the bolt in preparation for feeding. If the follower or feed lips are bent or broken, the rounds will become misaligned with the chamber and jam in the action. If the bolt face or extractor head/claw is worn or damaged, it can cause the round to cant as it is being fed into the chamber. If the feed ramp or barrel mouth are burred, damaged, or rough, it will cause the round to slow or stall and jam. If the cutoff malfunctions, it can prevent the magazine from feeding new rounds.

Repairing failure to feed malfunctions with internal box magazine-fed firearms is as simple as replacing broken, worn, or damaged parts. This includes the parts of the magazine (body, follower, and spring) and the bolt. If the feed ramp or chamber mouth is rough or burred, you can dress the parts with files and sandpaper. If the chamber is rough or undersized, you can polish or recut the chamber to SAAMI specs. If the chamber is excessively dirty, thoroughly clean and lightly lubricate the chamber.

Detachable box magazine-fed bolt-action firearms present a few additional factors to consider when diagnosing the designs. The magazine catch's purpose is to hold the magazine in place

so that it is aligned perfectly in the action. If the catch was broken, damaged, or worn, it would allow the magazine to shift its position in the receiver and move the rounds out of line with the bolt. If the catch is broken, damaged, or worn, replace the parts and perform a function check.

Unlike internal box magazines, the feed lips of metal detachable box magazines can sometimes be reshaped or rebent to properly align the cartridge for feeding. Over time, the magazine body, especially the feed lips, will experience hard use and possible damage that may cause the feed lips to move and change the alignment of the cartridge. Any change in the shape or spacing of the feed lips will cause the tip of the bullet to rise or dip beyond its point of alignment.

If the forward portion of the feed lips are much wider than the rear, the nose of the cartridge will rise and cause the cartridge to jam against the inside top of the breech. If the forward portion of the feed lips are narrower than the rear, the nose of the cartridge will dive and most likely jam against the front of the magazine body or into the feed ramp. The feed lips should be adjusted so that the tip of the cartridge is pointed straight into the chamber or slightly upward so that it will ride up the feed ramp.

Adjusting the feed lips is fairly simple and can be accomplished using pliers or specialty forming pliers available through Brownells. Make slight adjustments to the feed lips and make sure to adjust each side evenly. Perform a function check after each adjustment to verify the alignment of the snap caps or dummy rounds. You may have to adjust both the front and the rear of the feed lips to get the round in perfect alignment.

Bolt-Action Locking Problems

The next type of malfunction you may experience with bolt-action firearms is a failure to lock. A failure to lock occurs when the bolt is manipulated, but doesn't or can't complete its forward stroke so that the bolt's locking lugs fully engage the locking lugs located on the receiver. The bolt should close and lock on a cartridge smoothly with only slight resistance. You should never have to force the bolt closed.

There are two assemblies that can affect the locking step in the COO: the locking lugs located on the bolt and receiver and the bolt handle. If the locking lugs are damaged or burred, the lugs may not be able to fully engage or even begin to engage. This includes the lugs located on the bolt head or body and the lugs or lug recesses located in the receiver. Typically, the bolt handle will rest in a slot or cutout in the receiver, or act as a backup or redundant locking lug, or as the only locking lug (with low-power rimfire cartridges). If the handle is bent, it may not fit into its recess and allow the action to fully lock.

Depending on how much damage the lugs bear or how far out of spec the bolt is bent, you may be able to repair the bolt/handle and spare the expense of replacing them. If the lugs are only burred or feature minor dings, you can dress them with files and sandpaper. If the issue is with the lug located inside the receiver, you may have trouble reaching the area of the lug with the barrel installed. If the lug(s) is seriously damaged or broken, you will have to replace the bolt (head or body) or (worst case) the receiver.

If the bolt handle is bent and preventing the action from locking, you may be able to bend it enough to allow the action to close and lock. Depending on how far out of spec the handle is, you may be able to bend it "cold" or you may have to heat the handle up to bend it. Cold bending is simply done by hand (at room temperature), with the bolt body secured in a vise. Cold bending can only be done if the handle is slightly out of spec. Trying to bend a bolt handle too far without heat will result in a cracked or broken bolt handle. With the bolt secured in a vise, simply apply pressure by hand in the direction the handle needs to move in order for it to function. Move slowly and check for fit often. You only need to bend the handle enough to close and lock.

Figure 21: Bolt-action locking surfaces.

If the bolt handle is bent farther than can be fixed cold, you may have to bend the handle using heat, or you may have to just replace the bolt body (or complete bolt). Depending on how thick the bolt handle is and the point of the bend, you may be able to use a propane or MAP torch to get the handle hot enough. If the handle is thicker, you will have to use an oxy-acetylene torch to generate enough heat to bend the handle. You will also need some type of heat-blocking compound such as Brownells Heat Stop™ heat control paste to protect the bolt head and body from heat that may affect their temper.

Figure 22: Brownells Heat Stop paste.

Begin by stripping the bolt of the firing pin and other assemblies (extractor or ejector). You will have to get the bent area of the handle cherry red to white hot (~1500º – 2300º+ Fahrenheit) and you do not want any of that heat transferred to the locking lugs (or cocking cam) and possibly softening (annealing) the hardened surfaces. Heat the bent area evenly all the way around the handle and make sure the handle is hot throughout the bend (its core). Once the handle has been bent, you will need to let it air cure and (once it is cool to the touch) clean it off so that you can perform a function check. If the bolt closes and locks, you are done. If not, you may have to repeat the process.

Bolt-Action Cocking Problems

Moving through the cycle of operations, the next type of malfunction you may experience with bolt-action firearms would be a failure to cock. Most bolt-action rifles utilize a striker or some type of spring-loaded firing pin instead of a hammer. When the action is manipulated, the movement of the bolt (fore and aft) will set the firing pin or striker in the cocked position.

Depending on the specific model, the firing pin/striker will either be cocked when the action is opened (Mauser K98) or when the action is closed (Mauser K93). With the cock on open designs, when the bolt handle is rotated upward (unlocking the action), the striker/firing pin cams against a cocking cam/piece, which drives it backward and sets it in the cocked position. With the cock on closed designs, the bolt must be manipulated up and backward; it is not until the bolt is driven forward that the cocking cam/piece is captured by the FCG. As the bolt continues forward, the firing pin/striker is set to the cocked position.

Regardless of the design, failure to cock malfunctions can only be cause by a few factors. If a bolt-action rifle fails to cock, it is because either the cocking cam's/piece's sear surfaces are worn or damaged or the sear surface in the remainder of the FCG is worn or damaged. There may also be a chance that the sear surfaces are set at an incorrect angle.

Repairing failure to cock malfunctions with bolt-action rifles is as simple as replacing or repairing the parts. Typically, if you replace one part of the FCG (like the cocking cam/piece or the striker or firing pin), you will want to replace the corresponding part (like the sear inside the FCG). If the sear surfaces are set at an incorrect angle, you can dress them with stone files and sandpaper. Once the parts have been repaired or replaced, perform a function check and test fire the firearm.

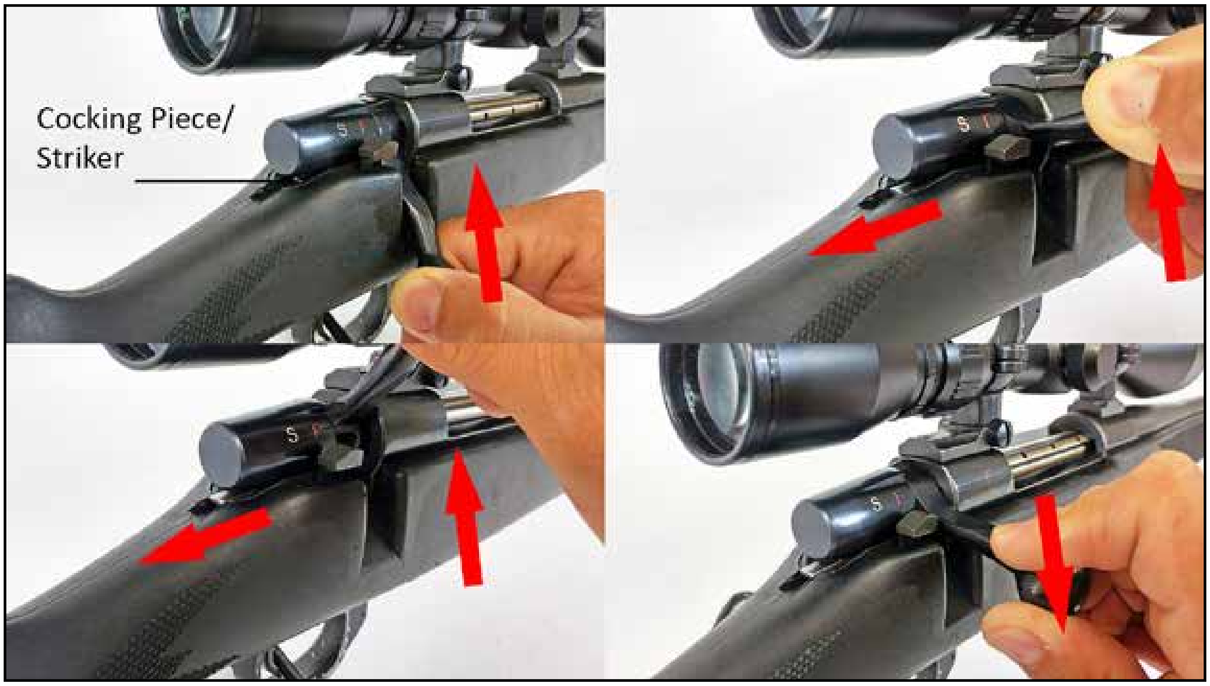

Figure 23a: Cock on open vs. cock on closed designs.

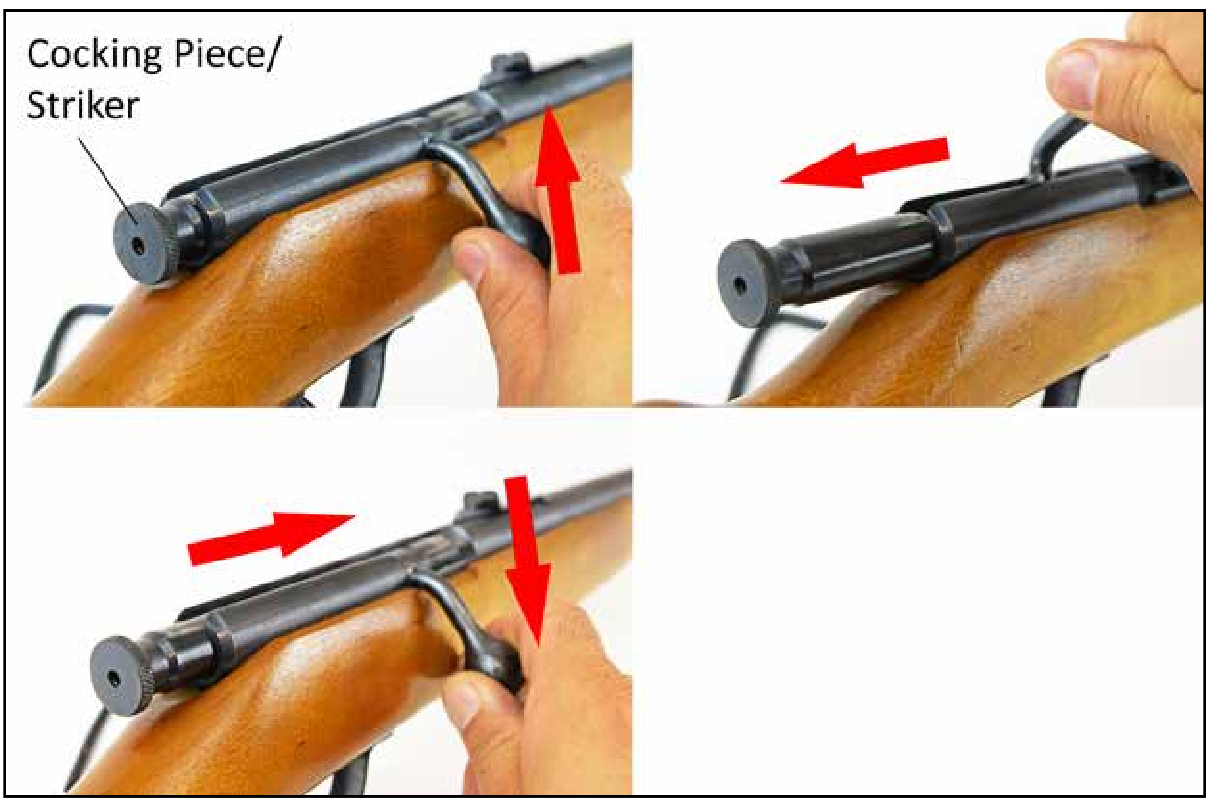

Figure 23b: Cock on open vs. cock on closed designs.

Bolt-Action Failure to Fire

Continuing through the cycle of operations, the next type of malfunction you may experience would be a failure to fire. There are only two basic reasons why a bolt-action rifle would experience a failure to fire: broken, damaged, or worn FCG parts or excessive dirt and debris. The most likely cause would be a worn or damaged firing pin/striker spring, which would cause light strikes. The next possible cause would be a broken or damaged firing pin/striker tip or body. The last possible cause would be excessive dirt and debris inside the FCG. The firing pin/striker and spring are typically housed in a channel in the

Figure 24: Bolt-action sear surfaces.

bolt body/head. If there is excessive dirt or debris in the channel, it may slow the firing pin/striker enough to cause a light strike malfunction.

Repairing failure to fire malfunctions is as simple as cleaning the FCG or replacing the worn or damaged parts. This means the firing pin/striker and spring. Typically, you will want to replace the firing pin/striker and spring to completely "refresh" the FCG. You can replace the worn or damaged parts, but you will be ensuring that sometime in the near future you will be replacing additional parts. Often, then-new parts will put strain against the old parts and cause them to expire prematurely.

Bolt-Action Unlocking Problems

Moving to the next step in the cycle of operations, the next malfunction you may experience would be a failure to unlock. The unlocking step is controlled by the bolt lugs, which means that if there is any damage or burrs on the lugs, the action may stick and fail to open. Repairing these malfunctions is as simple as repairing or replacing the damaged or broken parts (respectively).

Bolt-Action Failure to Extract Problems

Continuing through the cycle of operations, the next type of malfunction you may experience would be a failure to extract. When a failure to extract malfunction occurs, either the extractor (or its assembly) has failed or the chamber is excessively dirty or rough. If the extractor or its assembly is broken, damaged or worn, the extractor will not drive the case or will slip over the case rim. If the chamber is excessively dirty or rough, the case will stick to the chamber and cause the extractor to jump over the case rim.

If the failure to extract is caused by the extractor or its assembly, you can simply replace the damaged or worn parts to remedy the issue. If the failure to extract is caused by a rough chamber, the fix is a bit more involved. Repairing a rough chamber can be accomplished on a lathe with sandpaper and a dowel, or with Brownells Flex-Hone line of products.

Bolt-Action Firearm Ejecting Problems

The last type of malfunction you may experience with bolt-action firearms would be a failure to eject. Ejection with bolt-action rifles is (primarily) controlled by the operator. Ejection malfunctions can vary with bolt-action firearms because they employ two different ejector types: fixed and dynamic. Fixed ejectors are typically attached to the receiver of the firearm. As the action cycles and the bolt moves to the rear, the extractor will pull the case into the ejector and cause it to deflect away from the ejector and out of the ejection port. Much of the reliability of this type of ejection is dependent on the shape and location of the ejector and the force of the operator cycling the action.

Dynamic ejectors are typically spring-driven and live in the bolt face of the bolt/head. As the operator cycles the bolt, the ejector is placing constant force against the head cartridge case.

Figure 25: Bolt-action extractors.

Figure 26: Fixed vs. stationary ejectors.

Once the case has been fully extracted from the chamber, the ejector will immediately try to throw the case from the ejection port. The reliability of dynamic ejectors is less dependent on outside forces (the operator) and, in turn, provides more consistent ejection.

Repairing failure to eject malfunctions with certain bolt-action firearms is as simple as replacing broken, damaged, or worn parts. This includes the extractor/ejector, its assembly and its spring. If the firearm features an ejector that is fixed to the receiver and not removable, you may have to replace the whole receiver or weld up material to reshape the ejector. Once the assemblies are replaced, function check and test fire the firearm.

<table>
<tr><th colspan="3">BREAK- AND BOLT-ACTION TROUBLESHOOTING</th></tr>
<tr><th>Malfunction</th><th>Possible Causes</th><th>Solution</th></tr>
<tr><td>Failure to Feed</td><td>With Single-Shot Actions:
1. Burrs on the mouth of the chamber/no chamfer or bevel.
2. Dirty chamber.
3. Roughly machined chamber.
4. Undersized or out-of-spec chamber.
5. Damaged or worn bolt/breech face.

With Fixed Magazine Bolt-Actions:
6. Broken, damaged, or worn magazine parts including the spring, follower and feed lips. Damaged or worn bolt face.
7. Rough, damaged or worn feed ramp or chamber bevel/chamfer.
8. Damaged or broken extractor or ejector.

With Detachable Magazine Bolt-Actions:
9. Broken, damaged, or worn magazine parts including the magazine body, feed lips, floor plate, follower and spring.
10.Broken, damaged or worn magazine catch/release.</td><td>With Single-Shot Actions:
1. Remove burrs and smooth chamber mouth with sandpaper.
2. Thoroughly clean the chamber and lightly oil.
3. Polish, then clean and oil the chamber.
4. Recut the chamber to SAAMI specs.
5. Replace worn or damaged parts.

With Fixed Magazine Bolt-Actions:
6. Replace damaged or worn parts.
7. Dress the feed ramp or barrel mouth and polish the chamber.
8. Replace the extractor or ejector.

With Detachable Magazine Bolt-Actions:
9. Replace the whole magazine or parts of the magazine (if applicable). Reform or reshape the feed lips.
10.Replace the magazine catch/release and/or assembly.</td></tr>
</table>

Malfunction	Possible Causes	Solution
Failure to Lock	With Break-Actions: 1. Burrs on the locking surfaces. 2. Broken, damaged, or heavily worn locking surfaces. With Bolt-Actions: 1. Damage or burrs on the locking lugs of the bolt or the locking lugs on the receiver. 2. Bent or damaged bolt handle.	With Break-Actions: 1. Remove the burrs and clean up file marks with sandpaper. 2. Replace worn or damaged parts or assemblies. With Bolt-Actions: 1. Dress the locking lugs and remove any burrs or damage. Polish the lugs. 2. Replace the bolt handle/ assembly or bend the handle (if applicable).
Loose Lockup (Break-action)	1. Excessive wear on the barrel's locking lugs, pivot pin or pivot pin recess.	1. Replace the pivot pin. 2. Peen the barrel's locking and pivot surfaces to tighten up lockup.
Failure to Cock	With Break-Actions: 1. Broken, damaged, or worn cocking bar/lever or assembly. Damaged or worn FCG parts. Damaged hammer strut. 2. Worn sear surface(s). With Bolt-Actions: 1. Broken, damaged, or worn striker or assembly. Damaged or worn FCG parts. 2. Worn sear surfaces on the cocking cam/piece or striker.	With Break-Actions: 1. Replace parts with new or slightly used replacements. 2. Dress sear surfaces with stone files. With Bolt-Actions: 1. Replace broken, damaged, or worn parts. 2. Dress sear surfaces with stone files.
Failure to Fire	1. Excessive dirt and debris inside the FCG. 2. Broken, damaged, or worn FCG parts.	1. Clean the FCG. 2. Replace broken, damaged, or worn parts.

Malfunction	Possible Causes	Solution
Failure to Unlock	With Break-Actions: 1. Damaged or broken locking assembly parts. With Bolt-Actions: 2. Damage or burrs on the bolt lugs or lugs on the receiver.	With Break-Actions: 1. Replace damaged or broken parts. With Bolt-Actions: 2. Replace damaged or broken parts. Dress the bolt lugs and polish the surfaces.
Failure to Extract	1. Broken, damaged, or worn extractor or assembly. 2. Rough chamber. 3. Excessively dirty chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Polish the chamber. 3. Thoroughly clean and lightly oil the chamber.
Failure to Eject	With Break-Actions: 1. Broken, damaged, or worn ejector or assembly parts. With Bolt-Actions: 2. Broken, damaged, or worn ejector or assembly parts.	With Break-Actions: 1. Replace broken, damaged, or worn parts. With Bolt-Actions: 2. Replace broken, damaged, or worn parts. If the ejector is fixed to the receiver, you may have to replace the whole receiver.

NOTES

Chapter 3 - Troubleshooting Lever- and Pump-Actions

Troubleshooting Lever- and Pump-Actions

Pump- and lever-actions present unique challenges because of the increased complexity of their designs. Both designs typically utilize a tubular magazine that is mounted under the barrel and feeds rounds backward into the breech from the front of the receiver. This means there are an increased number of parts utilized to make these assemblies function correctly, which means more things that can go wrong. As long as you have a basic understanding of how these actions operate, troubleshooting should be straightforward.

LEVER-ACTION FIREARMS

The lever-action is a true repeating action design, which means that every step of the COO is performed by the action (even though the action is being driven by the operator). Because the lever-action design is (somewhat) affected by the skill of the operator, troubleshooting lever-actions can sometimes be difficult or frustrating. Once you have ruled out ammunition or operator error, troubleshooting lever-actions can be fairly simple.

Lever-Action Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a lever-action firearm can experience would be failures to feed. Once the lever-action firearm's magazine tube has been loaded by the operator (either through a loading gate in the receiver or directly into the tube near its muzzle end), the cartridge is fed into the chamber by the action that is being driven by the operator. With an empty chamber and a full magazine, the operator manipulates the lever (which drives the bolt, elevator/lifter, and cartridge trip/interrupter simultaneously) to load the first cartridge in the chamber. As the operator drives the lever (effort arm) down and forward and it pivots around a pin (fulcrum) in the receiver, the opposite end (load arm) of the lever drives the bolt backward, unlocking and opening the breech (Figure 1).

Simultaneously, assemblies inside the receiver will force the elevator/lifter downward and release one round from the feeding device onto the elevator. The elevator's downward movement will trip the cartridge trip/release (which will release one cartridge onto the elevator/lifter) and then trip the interrupter/stop (which will stop the next round in the magazine from entering the breech). When the operator has reached the end of the lever's stroke, the bolt will be fully to the rear of its travel, exposing the chamber, while the elevator/lifter will be angled downward with a single round sitting on its cradle.

Figure 1: Lever-action feeding cycle.

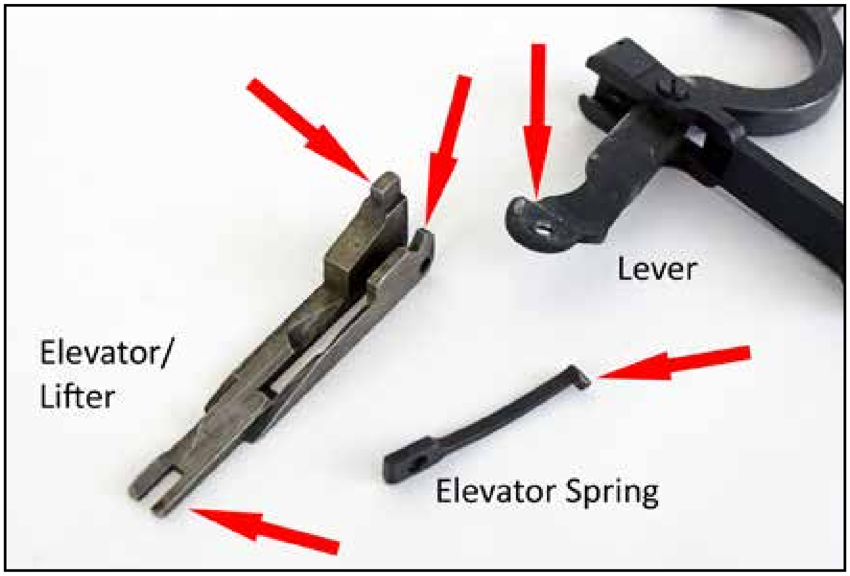

Figure 2: Feeding assembly parts contact wear.

As the operator begins to manipulate the lever back and up, the elevator/lifter will begin to rise and bring the cartridge into alignment with the bolt. Simultaneously, the bolt will begin to move forward as the round begins to rise into its path. The bolt head will meet the cartridge head and begin to drive the cartridge toward the chamber as the elevator/lifter rises to a point where the cartridge is in perfect alignment with the chamber. The bolt will continue forward, driving and locking the cartridge into the chamber. When the lever has completed its stroke, the bolt will be closed and locked on the cartridge and the elevator/lifter will be in its resting position, hovering around the bolt.

There are many things that can go wrong with the feeding step of a lever-action firearm. With a fairly complex feeding procedure that involves many separate assemblies, diagnosing feeding malfunctions can sometimes be very tricky. If any one of these parts or assemblies was to become broken, damaged, worn, or excessively dirty, they could easily cause a feeding malfunction. Typically, the most likely cause of failure to feed malfunctions with lever-action firearms is operator error. There is a very high probability the operator is short-stroking the action, trying to rapid fire, or working the action inconsistently.

Once operator error has been ruled out as the possible cause of the feed malfunction, you can focus on the remainder of the action. Beginning with the magazine tube, if any part of the feeding assembly (including the tube, follower and spring) were to become broken, damaged, or worn, the cartridges would fail to enter the breech. If the cartridge stop or interrupter was damaged or broken, cartridges may enter the breech prematurely or not at all. If the elevator/lifter is damaged or broken, it may fail to lift and align the cartridge in preparation for feeding (Figure 2). If the bolt is broken or damaged, it may cause misalignment of the cartridge while driving it into the chamber. If the extractor is damaged or broken, it may fail to jump over the rim of the cartridge or it may cause misalignment as the round is driven into the chamber. Any damage or wear on the lever can also cause any one of these assemblies to fail.

Lever-actions are also susceptible to other common causes of feeding malfunctions, such as the shape of the chamber mouth, a dirty or rough chamber, or excessive dirt and debris in the action. A broken or damaged extractor can also cause feeding malfunctions. Excessive wear on the contact points of any of these parts can cause timing issues in these assemblies that can

lead to feeding malfunctions. The lever-action design is heavily reliant on the timing of each assembly for proper function. Timing issues can be very difficult to diagnose sometimes because the action will behave differently as it is cycled (by hand) at various speeds. Any "play" that is created in these assemblies from wear or damage can cause intermittent malfunctions that may differ in each instance. The round may jam or hang-up in different areas of the feeding step, which will make diagnosing the cause of the malfunction a challenge.

Once the actual cause of the feed malfunction is determined, repairing feeding malfunctions with lever-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged parts or assemblies. This includes the parts and assemblies of the magazine tube, elevator/lifter, cartridge stop and interrupter, bolt and extractor, lever and chamber. If there is a timing issue, make certain to replace both parts/assemblies that are involved to avoid further issues later on. Make sure to perform both a function check and test fire once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Lever-Action Locking Problems

The next type of malfunction you may experience with lever-action firearms would be a failure to lock. The locking step of a lever-action firearm is controlled primarily by the short arm (load arm) of the lever or by a subassembly that is linked to and activated by the lever. The lever (or subassembly) will act as a locking lug, holding the breech closed during discharge.

As the operator drives the lever upward, one of two things may happen. If the lever is linked directly to the bolt, the load arm of the lever will drive the bolt forward, locking the breech with the leverage of the design. A secondary subassembly will hold the lever closed to ensure it will not fire out of battery.

If the action utilizes a subassembly to lock the breech, as the lever is driven closed, it will trip the locking assembly, which will arrest the bolt and lock the breech. The bolt may feature a recess designed for a locking lug that is located on the lever or in the receiver. As the lever moves upward into the closed position and the bolt moves forward into the locked position, the locking block/lug will move into the recess/lug on the bolt and lock the breech (Figure 3).

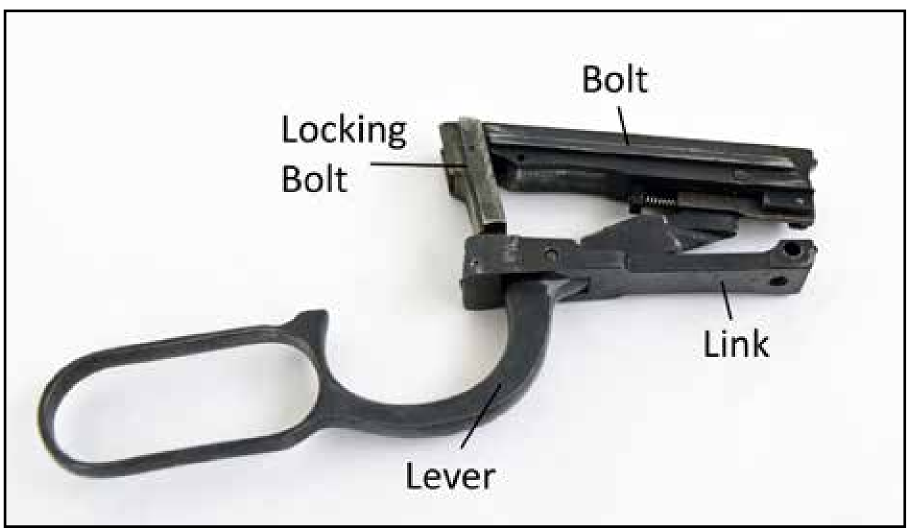

Figure 3: Lever-action locking assemblies.

If any of the parts or assemblies that control locking are excessively dirty, worn, broken, or damaged, they may cause the breech to fail to lock completely. Starting with the lever, if the lever or locking surface of the load arm of the lever is worn or damaged or if the lever itself is bent, it may fail to drive the bolt completely closed. If the pivot pin/screw is bent or broken, it may also cause the lever to fail to drive the bolt completely closed. If the locking recesses located on the bolt are damaged or worn, this may also cause the bolt to fail to completely lock. If the firearm utilizes a locking assembly that is separate from the lever and if any part of the assembly is broken, damaged, worn, or excessively dirty, it may fail to lock the bolt closed. The extractor and/or ejector may also cause locking issues. If the extractor (or in some cases with a dynamic ejector) becomes broken or damaged, it may fail to allow the bolt to fully seat against the head of the cartridge and prevent the bolt from locking-up against the chamber. Some lever-action designs may also utilize a small assembly to latch onto the lever in the closed position, providing a small amount of assurance the lever will not automatically fall, unlocking the chamber. If this assembly were to become broken, or damaged, it may allow the lever to prematurely unlock or not lock at all. Failure to lock can also be a result of an excessively dirty, rough, or undersized chamber. A failure to lock malfunction can also be the result of operator error, caused by short-stroking the action.

Once the actual cause of the locking malfunction is determined, repairing malfunctions with lever-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged parts or assemblies. This includes the lever, pivot pin/screw, locking assembly, bolt, or possibly the extractor/ejector. If the bolt must be replaced, make certain to perform a headspace check with the new bolt. Also, make sure to perform both a function check and test fire once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Lever-Action Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. Depending on the specific design of the firearm, the cocking step may be performed by either the action or the operator. When the action controls the cocking step, as the lever is manipulated down and forward (driving the bolt rearward), a ramped section on the rear of the bolt will drive the hammer back and down into the cocked position. When the operator controls the cocking step, once the lever has been manipulated through its complete stroke and there is a cartridge locked in the chamber, the operator must drive the hammer by the spur, by hand, into the cocked position.

When the hammer is set to the cocked position, it is trapped in place by the sear or the trigger. Sear "hooks" on the hammer are trapped by a ledge on the sear or trigger itself, which are in line with the path of rotation of the hammer's hooks. Either the sear or trigger is powered by a spring that is constantly driving it into the path of the hammer, preventing unintentional discharge caused by a runaway hammer.

Regardless of whether the cocking step is controlled by the action or by the operator, the causes for a failure to cock are (typically) the same. Typically, the most common cause of a failure to cock would be damaged or broken sear engagement surfaces or broken, damaged, or dirty FCG parts. If the hooks on the hammer or the shearing surfaces on the sear or trigger are broken, damaged, or worn, the hammer will

slip over/past the sear/trigger and fail to cock. If the springs that drive the sear/trigger are damaged or worn, they may fail to force the sear/trigger into the path of the hammer and cause a failure to cock. If either of these assemblies is excessively dirty, it may slow the parts enough to cause timing issues in the FCG and cause a failure to cock.

A few least likely causes for a failure to cock would include the hammer strut and spring, the bolt, and the safety. If the hammer strut or spring is damaged or broken, it may not allow the hammer to travel far enough back into its travel to engage the sear/trigger. If the cocking surface of the bolt or the face of the hammer is excessively worn or damaged, the bolt may fail to drive the hammer down far enough to engage the sear/trigger. Depending on the design of the FCG, the safety may block the movement of the hammer/sear/trigger. If the safety were to fail, it could inadvertently block the hammer/sear/trigger and prevent the hammer from cocking.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer, strut, hammer spring, sear/trigger, bolt, safety, and springs. You may want to replace both sear surfaces (the sear/trigger and hammer) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Lever-Action Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. There are only two basic reasons why a lever-action firearm would experience a failure to fire: broken, damaged, or worn FCG parts or excessive dirt and debris. The most likely cause would be a worn or damaged firing pin, hammer, or hammer spring. If the hammer or firing pin is damaged or broken, the firing pin may fail to even reach the primer. If the hammer/mainspring is damaged or worn, the firing pin may only create a "light strike."

The next possible cause would be excessive dirt and debris inside the FCG. The firing pin spring is housed in a channel in the bolt head. If there is excessive dirt or debris in the channel, it may slow the firing pin enough to cause a light strike malfunction or seize the firing pin completely.

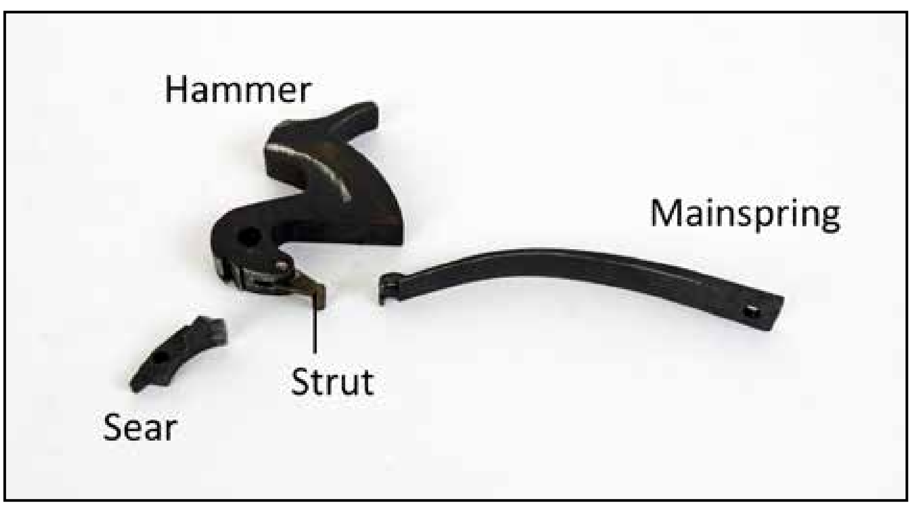

Figure 4: Parts of a lever-action FCG that could cause a failure to cock.

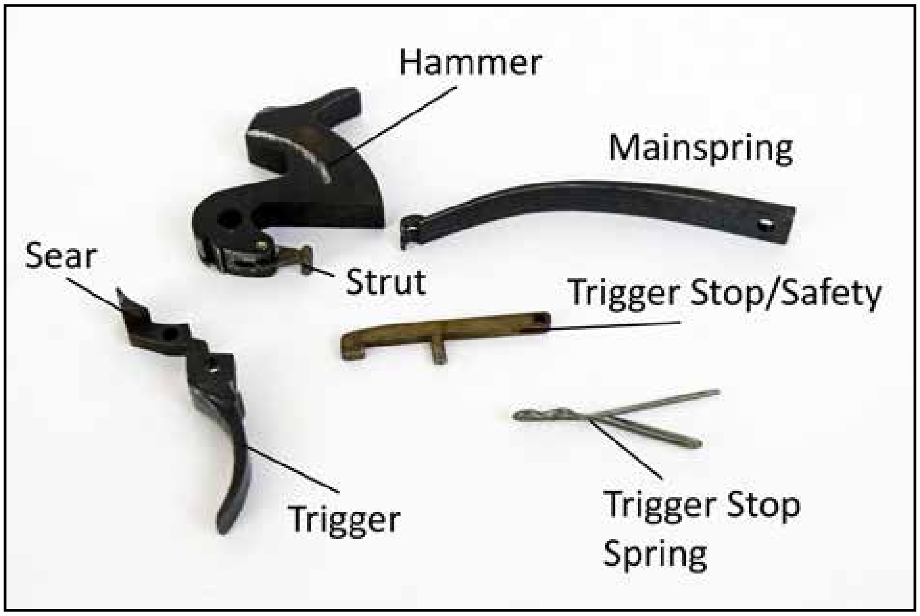

Figure 5: Lever-action FCG parts.

Another and less likely cause of a failure to fire would come from a malfunctioning safety. If the safety were to fail, it could jam the FCG and prevent either the trigger or hammer from moving. The safety could also apply enough drag to FCG parts to cause a light strike.

Repairing failure to fire malfunctions is as simple as cleaning the FCG or replacing the worn or damaged parts. This means the firing pin, hammer, hammer spring, strut, sear/trigger or safety. Typically, you will want to replace the worn or damaged parts and springs to completely "refresh" the FCG. You can replace the worn or damaged parts, but this will ensure that sometime in the near future you will be replacing additional parts. Often, new parts will put strain against the old parts and cause them to expire prematurely.

Lever-Action Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. Like the locking step, the unlocking step is controlled primarily by the operator. When the operator manipulates the lever down and forward, the short arm (load arm) of the lever or linkage will drive the bolt rearward, unlocking the breech. Some designs also utilize a separate locking assembly that is activated by the lever.

If any of the parts or assemblies that control unlocking are excessively dirty, worn, broken, or damaged, they may cause the breech to fail to open. Starting with the lever, if the lever or locking surface of the load arm of the lever is worn or damaged or if the lever itself is bent, it may fail to drive the bolt open. If the pivot pin/screw is bent or broken, it may also cause the lever to fail to drive the bolt completely open. If the locking recesses located on the bolt are damaged or worn, this may also cause the bolt to fail to completely unlock. If the firearm utilizes a locking assembly that is separate from the lever, if any part of the assembly is broken, damaged, worn, or excessively dirty, it may fail to release the bolt and unlock the breech. The safety can also create a failure to unlock with some designs, as it can block the hammer/trigger and prevent the bolt from moving rearward; but this is the least likely scenario.

Once the actual cause of the unlocking malfunction is determined, repairing malfunctions with lever-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged

parts or assemblies. This includes the lever, pivot pin/screw, locking assembly, or possibly the bolt or safety. If the bolt must be replaced, make certain to perform a headspace check with the new bolt. Also, make sure to perform both a function check and test fire once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Lever-Action Extracting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract. When the operator manipulates the lever to unlock the action, the extractor (affixed to the bolt) will begin to pull the empty case from the chamber as the bolt is driven rearward by the lever. The extractor will hold the empty case against the bolt face until the round is ejected. The extractor may feature an integral spring design or may use a separate spring to drive the extractor claw.

If any part of the extractor assembly were to fail because of breakage, damage, or wear, it would cause a failure to extract. This includes the extractor itself and the extractor spring and pin (if applicable). If the extractor claw is broken, damaged, or worn, it will jump over the case rim and leave the empty case in the chamber. If the extractor spring or the extractor itself becomes weak or worn, the empty case may only be partially extracted before the extractor claw slips over the case rim. If the extractor pin (if applicable) is bent or broken, it may also cause a fail to extract.

A failure to extract malfunction can also be caused by the chamber of the firearm. If the chamber is excessively rough, it may place too much friction against the case and cause extraction malfunctions. If the chamber is excessively dirty, it may also cause a failure to extract.

If the failure to extract is caused by the extractor or its assembly, you can simply replace the damaged or worn parts to remedy the issue. If the failure to extract is caused by a rough chamber, the fix is a bit more involved. Repairing a rough chamber can be accomplished on a lathe with sandpaper and a dowel, or with Brownells Flex-Hone line of products.

Lever-Action Ejecting Problems

The last type of malfunction that may occur would be a failure to eject. Lever-action firearms typically feature a fixed ejector that is integral to or affixed to the receiver. When the operator

Figure 6: Lever-action extractor.

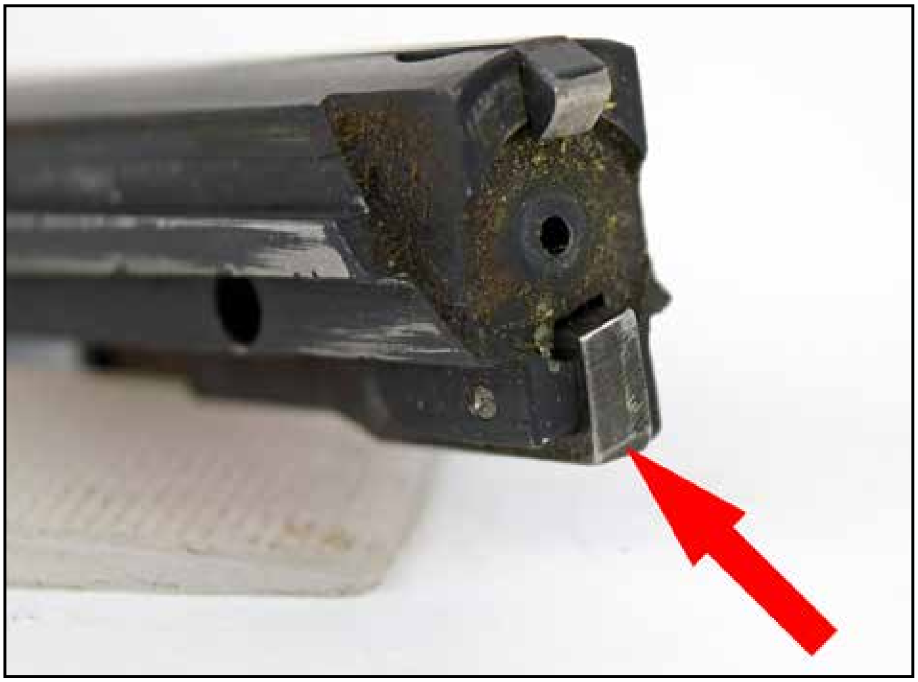

Figure 7: Lever-action ejector.

manipulates the lever and drives the bolt rearward, the extractor will pull the empty case from the chamber and directly into the ejector, which will kick the case from the breech. Sometimes, the ejector design utilizes a small flat (or coil) spring to constantly place force against the ejector, but will allow it to slightly compress as the bolt passes over it. This design allows for the largest possible ejection surface without affecting function. You may also encounter dynamic ejectors located in the face of the bolt that place constant force on the case head.

If the firearm utilizes a fixed or sprung ejector affixed to the receiver, much of the force and reliability of ejection is going to come from skill of the operator. This means that the operator must manipulate the lever fast enough to drive the bolt and empty case into the ejector so that the case will clear the breech. If the design utilizes a dynamic ejector that lives in the bolt face, ejection is less reliant on the operator.

If the ejector or ejector assembly were to become broken, damaged, worn, or excessively dirty, the firearm may start to experience failure to ejects. If the firearm utilizes a fixed (or sprung) ejector located in the receiver and it becomes worn or damaged, you will begin to experience erratic ejection or ejection that fails to clear the breech. If the design utilizes a spring and it becomes worn or damaged, the empty cases may fail to eject at all. If the design utilizes an ejector located in the bolt face and the ejector or springs become worn or damaged, the firearm will experience erratic ejection or may fail to eject empty cases at all.

Repairing failure to eject malfunctions with certain lever-action firearms is as simple as replacing broken, damaged, or worn parts. This includes the ejector and, if applicable, its spring. If the firearm features an ejector that is fixed to the receiver and is not removable, you may have to replace the whole receiver or weld up material to reshape the ejector. If the ejector is located in the bolt face, you simply need to replace the parts. Once the assemblies are replaced, function check and test fire the firearm.

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Pump-Action Firearms

Like the lever-action, the pump-action is a true repeating action design, which means that every step of the COO is performed by the action (even though the action is being driven by the operator). Because the pump-action design is (somewhat) affected by the skill of the operator, troubleshooting pump-actions can sometimes be difficult or frustrating. Once you have ruled out ammunition or operator error, troubleshooting pump-actions can be fairly simple.

Pump-Action Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a pump-action firearm can experience would be failures to feed. Once the pump-action firearm's magazine tube has been loaded by the operator, the cartridge is fed into the chamber by the action that is being driven by the operator. With an empty chamber and a full magazine, the operator manipulates the forend, or slide (which drives the bolt/carrier, elevator/lifter and cartridge trip/interrupter simultaneously), to load the first cartridge in the chamber. As the operator drives the slide backward, the slide/action bar (which is fixed to the slide) drives the bolt/carrier backward, unlocking and opening the breech.

Simultaneously, assemblies on the bolt or inside the receiver will force the elevator/lifter downward and release one round from the feeding device onto the elevator. Depending on design, the elevator's downward movement, the bolt moving rearward, or the slide/action bar(s) will trip the cartridge trip/release (which will release one cartridge onto the elevator/lifter) and then trip the interrupter/stop (which will stop the next round in the magazine from entering the breech). When the operator has reached the end

Figure 8: Pump-action feeding cycle.

of the slide's stroke, the bolt will be fully to the rear of its travel (exposing the chamber), while the elevator/lifter will be angled downward with a single round sitting on its cradle.

As the operator begins to manipulate the slide forward, the elevator/lifter will begin to rise and bring the cartridge into alignment with the bolt. Simultaneously, the bolt will begin to move forward as the round begins to rise into its path. The bolt head will meet the cartridge head and begin to drive the cartridge toward the chamber as the elevator/lifter rises to a point where the cartridge is in perfect alignment with the chamber. The bolt will continue forward, driving and locking the cartridge into the chamber. When the slide has completed its stroke, the bolt will be closed and locked on the cartridge and the elevator/lifter will be in its resting position, hovering around the bolt.

There are many things that can go wrong with the feeding step of a pump-action firearm. With a fairly complex feeding procedure that involves many separate assemblies, diagnosing feeding malfunctions can sometimes be very tricky. If any one of these parts or assemblies was to become broken, damaged, worn, or excessively dirty, they could easily cause a feeding malfunction. Typically, the most likely cause of failure to feed malfunctions with pump-action firearms is operator error. There is a very high probability the operator is short-stroking the action when trying to rapid fire.

Once operator error has been ruled out as the possible cause of the feed malfunction, you can focus on the remainder of the action. Beginning with the magazine tube, if any part of the feeding assembly (including the tube, follower and spring) were to become broken, damaged, or worn, the cartridges would fail to enter the breech. If the cartridge stop or interrupter was damaged or broken, cartridges may enter the breech prematurely or not at all. If the elevator/lifter is damaged or broken, it may fail to lift and align the cartridge in preparation for feeding. If the bolt or bolt carrier is broken or damaged, it may cause misalignment of the cartridge while driving it into the chamber. If the extractor(s) is damaged or broken, it may fail to jump over the rim of the cartridge or it may cause misalignment as the round is driven into the chamber. Any damage or wear on the slide or action/slide bars can also cause any one of these assemblies to fail. Pump-actions are also susceptible to other common causes of feeding malfunctions, such as excessive dirt and debris in the action and a dirty or rough chamber.

Excessive wear on the contact points of any of these parts can cause timing issues in these assemblies that can lead to feeding malfunctions. The pump-action design is heavily reliant on the timing of each assembly for proper function. Timing issues can be very difficult to diagnose sometimes because the action will behave differently as it is cycled (by hand) at various speeds. Any "play" that is created in these assemblies from wear or damage can cause intermittent malfunctions that may differ in each instance. The round may jam or hang-up in different areas of the feeding step, which will make diagnosing the cause of the malfunction a challenge.

Once the actual cause of the feed malfunction is determined, repairing feeding malfunctions with pump-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged parts or assemblies. This includes the parts and assemblies of the magazine tube, elevator/lifter, cartridge stop and interrupter, bolt, carrier and extractor, slide, action/slide bars and chamber. If there is a timing issue, make certain to replace both parts/assemblies that are involved to avoid further issues later on. Also, make sure to perform both a function check and test fire

once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Pump-Action Locking Problems

The next type of malfunction you may experience with pump-action firearms would be a failure to lock. With pump-action firearms, the locking step in the COO is typically accomplished with some type of locking assembly. When the operator manipulates the slide forward to lock the breech, the slide/action bar(s) will drive the bolt/carrier forward until the bolt bottoms out against the chamber end of the barrel.

Depending on design, the breech may lock in one of two ways. If the design utilizes a bolt carrier (Mossberg 500/Remington 870), then when the bolt bottoms out against the barrel, the carrier will continue forward, driving a locking lug upward into a locking recess. A protrusion on the bolt carrier will cam against a locking lug (that pivots in the body of the bolt) and drive the locking lug upward. Depending on specific design, the locking lug in the bolt will engage a cutout or recess that is either located in the barrel (which is recessed into the receiver) or into a locking recess directly in the receiver.

If the design does not utilize a bolt carrier (Winchester 1897), then when the bolt bottoms out against the barrel, a subassembly or the elevator/lifter will rise upward, engaging the bolt and locking the breech. The locking assembly is either tripped by the bolt or by the slide/action bar(s). With the Winchester 1897, the elevator/lifter doubles as a locking assembly.

Regardless of design, once the breech is locked, a secondary assembly will provide a secondary, redundant lock that also doubles as a means to unload the firearm. The bolt/action release blocks the bolt/carrier and prevents the action from being cycled once the action is loaded. A small arm or tab will engage a recess in the bolt/carrier or block the rear of the bolt and prevent its rearward movement until the round is fired or the operator manipulates the bolt/action release.

If any of the parts that control locking are broken, damaged, worn, or excessively dirty, they can cause a failure to lock. If the slide/action bar is broken or damaged, it may fail to drive the bolt completely forward or may fail to trip the locking assembly. With carrier designs, if the carrier, locking lug, or barrel/receiver is broken, damaged, or worn, the breech may fail to lock completely or may come unlocked during

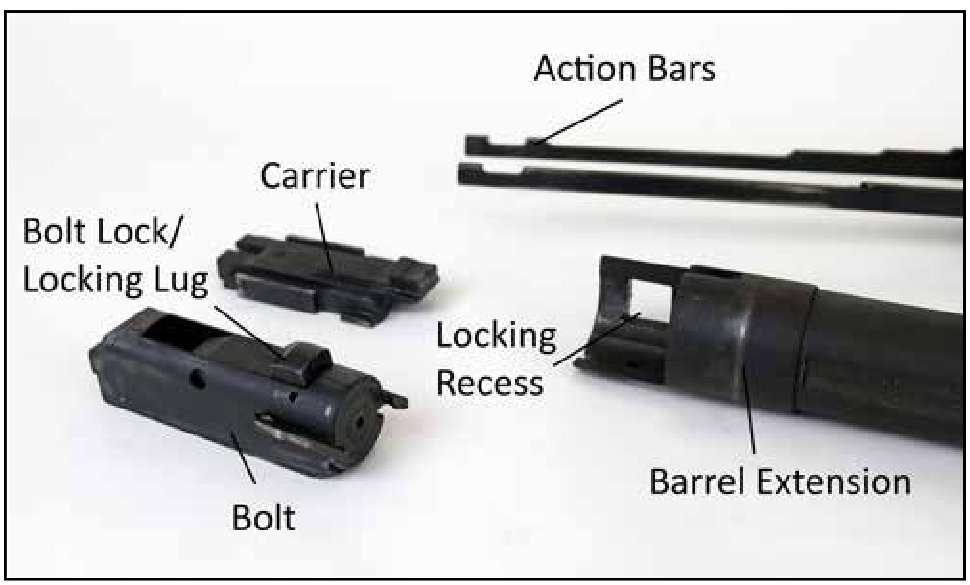

Figure 9: Parts of a pump-action locking assembly.

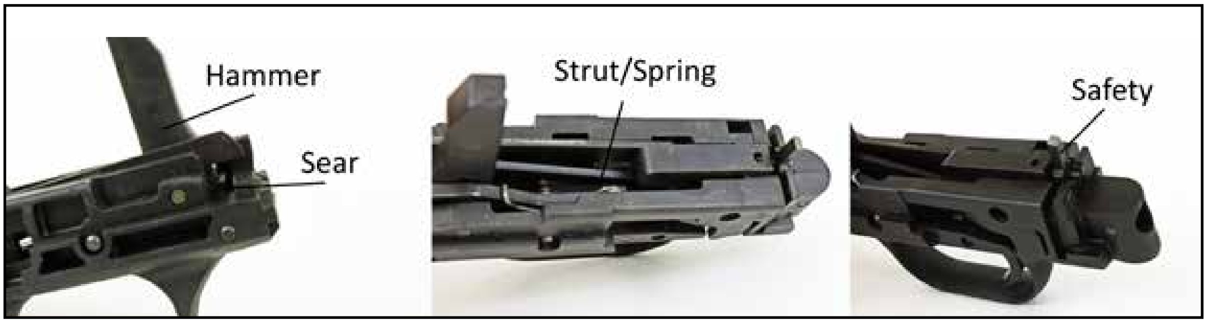

Figure 10: Parts of a pump-action FCG that could cause a failure to cock.

discharge. With non-carrier designs, if the slide/action bar(s) or bolt or elevator/locking assembly is broken, damaged or worn, it can also lead to a failure to lock. If any part of the bolt/action release assembly is broken, damaged, or worn, it may allow the breech to unlock during discharge and create a very dangerous situation. If any of these parts become excessively dirty, it may also lead to locking malfunctions.

Once the actual cause of the locking malfunction is determined, repairing malfunctions with pump-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged parts or assemblies. This includes the slide, slide/action bar(s), locking lug or locking assembly, bolt/carrier or possibly the barrel/receiver or even the elevator/lifter. If the bolt must be replaced, make certain to perform a headspace check with the new bolt. Also, make sure to perform both a function check and test fire once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Pump-Action Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. Depending on the specific design of the firearm, the cocking step may be performed by either the action or the operator. When the action controls the cocking step, as the slide is manipulated backward (driving the bolt rearward), a ramped section on the rear of the bolt/carrier will drive the hammer back and down into the cocked position. When the operator controls the cocking step, once the slide has been manipulated through its complete stroke and there is a cartridge locked in the chamber, the operator must drive the hammer by the spur, by hand, into the cocked position.

When the hammer is set to the cocked position, it is trapped in place by the sear or the trigger. Sear "hooks" on the hammer are trapped by a ledge on the sear or trigger itself, which are in line with the path of rotation of the hammer's hooks. Either the sear or trigger is powered by a spring that is constantly driving it into the path of the hammer, preventing unintentional discharge caused by a runaway hammer.

Regardless of whether the cocking step is controlled by the action or by the operator, the causes for a failure to cock are (typically) the same. Typically, the most common cause of a failure to lock would be damaged or broken sear engagement surfaces or broken, damaged, or dirty FCG parts. If the hooks on the hammer or the shearing surfaces on the sear or trigger are broken, damaged, or worn, the hammer will slip over/past the sear/trigger and fail to cock. If the springs that drive the sear/trigger are damaged or worn, they may fail to force the sear/trigger into the path of the hammer and cause a failure to cock. If either of these assemblies is excessively dirty, it may slow the parts enough to cause timing issues in the FCG and cause a failure to cock.

A few least likely causes for a failure to cock would include the hammer strut and spring, the bolt, and the safety. If the hammer strut or spring is damaged or broken, it may not allow the hammer to travel far enough back into its travel to engage the sear/trigger. If the cocking surface of the bolt/carrier or the face of the hammer is excessively worn or damaged, the bolt may fail to drive the hammer down far enough to engage the sear/trigger. Depending on the design of the FCG, the safety may block the movement of the hammer/sear/trigger. If the safety were to fail, it could inadvertently block the hammer/sear/trigger and prevent the hammer from cocking.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer, strut, hammer spring, sear/trigger, bolt, safety, and springs. You may want to replace both sear surfaces (the sear/trigger and hammer) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Pump-Action Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. There are only two basic reasons why a pump-action firearm would experience a failure to fire: broken, damaged, or worn FCG parts or excessive dirt and debris. The most likely cause would be a worn or damaged firing pin, hammer, or hammer spring. If the hammer or firing pin is damaged or broken, the firing pin may fail to even reach the primer. If the hammer/mainspring is damaged or worn, the firing pin may only create a "light strike."

The next possible cause would be excessive dirt and debris inside the FCG. The firing pin spring is housed in a channel in the bolt head. If there is excessive dirt or debris in the channel, it may slow the firing pin enough to cause a light strike malfunction or seize the firing pin completely. Because the locking lug lives in the bolt and the firing pin passes through the lug, if the

Figure 11: Pump-action FCG parts.

locking lug is broken, bent, or damaged, it may slow or stall the firing pin and cause a failure to fire or light strike.

Another and less likely cause of a failure to fire would come from a malfunctioning safety. If the safety were to fail, it could jam the FCG and prevent either the trigger or hammer from moving. The safety could also apply enough drag to FCG parts to cause a light strike.

Repairing failure to fire malfunctions is as simple as cleaning the FCG or replacing the worn or damaged parts. This means the firing pin, hammer, hammer spring, strut, sear/trigger, locking lug or safety. Typically, you will want to replace the worn or damaged parts and springs to completely "refresh" the FCG. You can replace the worn or damaged parts, but doing so will ensure that sometime in the near future you will be replacing additional parts. Often, new parts will put strain against the old parts and cause them to expire prematurely.

Pump-Action Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. Like the locking step, the unlocking step is controlled primarily by the operator. When the operator manipulates the slide backward, the slide/action bar(s) will drive the bolt rearward, unlocking the breech. When the slide/action bar(s) begins to drive the bolt carrier rearward, the lug on the carrier will clear the path of the locking lug and allow the lug to drop out of the locking recess in the barrel/receiver.

Some designs also utilize a separate locking assembly that is activated by the slide/action bar(s) or bolt. Some designs utilize an elevator/lifter that doubles as a locking surface. When the slide/action bar begins to drive the bolt rearward, a trip on the bolt or slide/action bar(s) will begin to force the elevator/lifter down and out of the path of the bolt so the breech can unlock.

If any of the parts or assemblies that control unlocking are excessively dirty, worn, broken, or damaged, they may cause the breech to fail to open. Starting with the slide, if the slide or slide bar(s) is worn or damaged or if the slide bar(s) itself is bent, it may fail to drive the bolt open. If the bolt/carrier or locking lug(s), including the lug recesses in the barrel/receiver, is broken, damaged, or worn, the action may become stuck and fail to unlock. If the locking assembly or elevator/lifter is broken or damaged, it may fail to release the bolt and unlock the breech. If the bolt/action release assembly is broken, damaged, or worn, it may fail to clear the path of the bolt/carrier and not allow the breech to open. The safety can also create a failure to unlock with some designs, as it can block the hammer/trigger and prevent the bolt from moving rearward; but this is the least likely scenario.

Once the actual cause of the unlocking malfunction is determined, repairing malfunctions with pump-action firearms is as simple as cleaning, repairing, or replacing the worn or damaged parts or assemblies. This includes the slide, slide/action bars, locking assembly, locking lug, elevator/lifter, bolt/action release, or possibly the bolt/carrier or safety. If the bolt must

Figure 12: Pump-action extractor.

be replaced, make certain to perform a headspace check with the new bolt. Also, make sure to perform both a function check and test fire once you have repaired or replaced the broken, damaged, or worn assemblies. If the cause of the malfunctions is excessive dirt and debris, thoroughly clean and lightly lubricate the action.

Pump-Action Extracting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract. When the operator manipulates the slide to unlock the action, the extractor (affixed to the bolt) will begin to pull the empty case from the chamber as the bolt is driven rearward by the slide/action bar(s). The extractor will hold the empty case against the bolt face until the round is ejected. The extractor may feature an integral spring design or may use a separate spring to drive the extractor claw.

If any part of the extractor assembly were to fail because of breakage, damage, or wear, it would cause a failure to extract. This includes the extractor itself and the extractor spring and pin (if applicable). If the extractor claw is broken, damaged, or worn, it will jump over the case rim and leave the empty case in the chamber. If the extractor spring or the extractor itself becomes weak or worn, the empty case may only be partially extracted before the extractor claw slips over the case rim. If the extractor pin (if applicable) is bent or broken, it may also cause a fail to extract.

A failure to extract malfunction can also be caused by the chamber of the firearm. If the chamber is excessively rough, it may place too much friction against the case and cause extraction malfunctions. If the chamber is excessively dirty, it may also cause a failure to extract. If the failure to extract is caused by the extractor or its assembly, you can simply replace the damaged or worn parts to remedy the issue. If the failure to extract is caused by a rough chamber, the fix is a bit more involved. Repairing a rough chamber can be accomplished on a lathe with sandpaper and a dowel, or with Brownells Flex-Hone line of products.

Pump-Action Ejecting Problems

The last type of malfunction that may occur would be a failure to eject. Pump-action firearms typically feature a fixed ejector that is integral to or affixed to the receiver. When the operator manipulates the slide and drives the bolt

Figure 13: Pump-action ejector.

rearward, the extractor will pull the empty case from the chamber and directly into the ejector, which will kick the case from the breech. Sometimes, the ejector design utilizes a small flat (or coil) spring to constantly place force against the ejector, but will allow it to slightly compress as the bolt passes over it. This design allows for the largest possible ejection surface without affecting function. With the pump-action design, much of the force and reliability of ejection is going to come from skill of the operator. This means that the operator must manipulate the slide fast enough to drive the bolt and empty case into the ejector so that the case will clear the breech.

If the ejector or ejector assembly were to become broken, damaged, worn, or excessively dirty, the firearm may start to experience failure to ejects. If the ejector is worn or damaged, the firearm will experience erratic ejection. If the ejector is broken, the empty cases may fail to eject the breech and become jammed in the action.

Repairing failure to eject malfunctions with pump-action firearms is as simple as replacing broken, damaged, or worn parts. This includes the ejector and, if applicable, its spring. If the firearm features an ejector that is fixed to the receiver and not removable, you may have to replace the whole receiver or weld up material to reshape the ejector. Once the assemblies are replaced, function check and test fire the firearm.

LEVER- AND PUMP-ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Feed	1. Burrs on the mouth of the chamber/no chamfer or bevel. 2. Dirty chamber. 3. Roughly machined chamber. 4. Undersized or out-of-spec chamber. 5. Damaged or worn bolt/breech face. Broken, damaged, or worn magazine parts including the spring, tube, follower and stop/interrupter. Damaged or worn elevator/lifter, lever/slide or bolt face/carrier. Damaged or broken extractor.	1. Remove burrs and smooth chamber mouth with sandpaper. 2. Thoroughly clean the chamber and lightly oil. 3. Polish, then clean and oil the chamber. 4. Recut the chamber to SAAMI specs. 5. Replace worn or damaged parts.
Failure to Lock	With Lever-Actions: 1. Broken, damaged or worn lever, pivot pin/screw, or bolt. 2. Broken, damaged or worn locking assembly parts. 3. Broken or damaged extractor or ejector. 4. Broken or damaged lever latch. 5. Excessively dirty, rough or undersized chamber. With Pump-Actions: 1. Broken, damaged, or worn slide, slide/action bar(s), or bolt carrier. 2. Broken, damaged, or worn bolt, locking assembly/locking lug or elevator/lifter. 3. Broken, damaged, or worn barrel or receiver. 4. Broken, damaged, or worn bolt/action release. 5. Excessive dirt and debris in the locking assemblies.	With Lever-Actions: 1. 1 – 4: Replace worn or damaged parts. 5. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs. With Pump-Actions: 1. 1 – 4: Replace worn or damaged parts. 5. Thoroughly clean and oil the chamber.

Malfunction	Possible Causes	Solution
Failure to Cock	1. Broken, damaged, or worn sear surfaces. Broken or damaged FCG parts, including the strut, springs and selector. 2. Worn cocking surfaces on the bolt/carrier/hammer.	1. Replace worn or damaged parts. Some sear surfaces can be dressed and polished. 2. Replace worn or damaged parts.
Failure to Fire	1. Excessive dirt and debris inside the FCG. 2. Broken, damaged or worn FCG parts.	1. Clean the FCG. 2. Replace broken, damaged, or worn parts.
Failure to Unlock	With Lever-Actions: 1. Broken, damaged, or worn locking assemblies, including the lever, lever pin, locking assembly, bolt and safety. With Pump-Actions: 1. Broken, damaged, or worn locking assemblies, including the slide, slide/action bar(s), bolt/carrier, elevator/lifter, locking lug, or bolt/action release.	With Lever-Actions: 1. Broken, damaged, or worn parts. With Pump-Actions: 1. Replace broken, damaged, or worn parts.
Failure to Extract	1. Broken, damaged, or worn extractor or assembly. 2. Rough chamber. 3. Excessively dirty chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Polish the chamber. 3. Thoroughly clean and lightly oil the chamber.
Failure to Eject	1. Broken, damaged, or worn ejector or assembly parts.	1. Replace broken, damaged, or worn parts.

Troubleshooting Revolvers

Revolvers present many challenges if you are not completely familiar with their design. Revolver actions differ from every other action type and have a unique cycle of operations. There are two basic revolver action designs: single and double action. The main difference between the two action types lies in the function of the fire control group.

SINGLE-ACTION REVOLVERS

The single-action system is the original revolver action and the oldest repeating handgun design. The single-action design is also much simpler compared to the double-action design and slightly easier to diagnose. Much of the

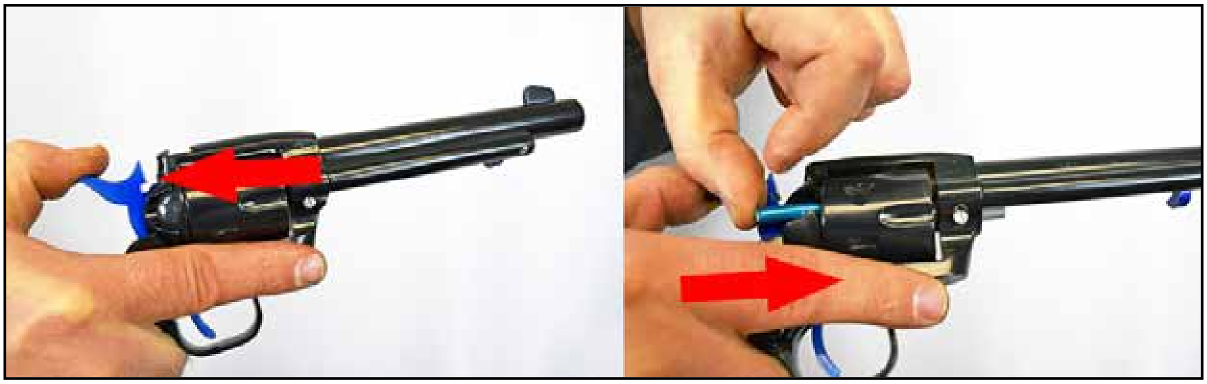

Figure 1: The first stage of the feeding step of a single-action revolver.

single-action revolver's cycle of operations is controlled by the operator, which makes operator error a factor when diagnosing issues. Once operator error has been ruled out, you can focus on the remainder of the factors.

Single-Action Revolver Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a single-action revolver action can experience would be failures to feed. The feeding step of a single-action revolver is a two-phase process that involves both the action and the operator. The first stage of the feeding step of a single-action revolver involves setting the hammer to the "half-cock" position, which (through linkage) moves the hand out of the path of the ratchet and clears the cylinder stop from the cylinder stop notch*. This frees the movement of the cylinder around the base pin. A hinged part known as the loading gate is swung outward from the frame, exposing the first chamber of the cylinder. The operator loads a single cartridge into the exposed chamber and rotates the cylinder clockwise (looking from the breech end) to expose the next chamber. The operator will continue to load each chamber until the cylinder is full. Once the cylinder is loaded, the operator closes the loading gate to prevent rounds from falling out of the cylinder. This is the end of the first stage of the loading process.

Once the cylinder has been loaded and the loading gate has been closed, the second stage of the feeding process begins. This second stage of the process is semi-automated and is activated when the operator sets the hammer from half-cock to full-cock. As the operator moves the hammer back and down into the cocked position, linkage on the hammer will activate the hand assembly, driving it up and forward under spring force, which will act upon the ratchet, causing the cylinder to rotate clockwise around the base pin and bring the first chamber into alignment with the barrel. Simultaneously, the cocking of the hammer will also force the trigger to drive the cylinder stop upward, locking the cylinder into alignment with the barrel. This is the end of the second stage of the feeding process.

Because the feeding step of a single-action revolver involves two separate stages, you must diagnose each stage separately. Beginning with the first stage, if the leading edge of the chamber is burred or does not feature a chamfer, it may cause the cartridge to catch the edge of the chamber. If the hammer or hand assembly is

**Disclaimer: Some manufacturers use different terms for the same parts of a revolver:*

1. *The term "finger" is also used in describing hand.*
2. *Cylinder stop is also known as the cylinder "bolt," "latch," or "lock."*
3. *Cylinder stop notch is also referred to as the "cylinder bolt stop."*

Figure 2: The second stage of the feeding step of a single-action revolver.

broken, damaged, or worn, it may fail to release the ratchet when the hammer is set to half-cock. If there is excessive dirt, debris, or moisture between the cylinder and base pin, it may cause the cylinder to seize. A roughly machined or undersized chamber can also lead to feeding issues.

During the second stage of a single-action revolver's feeding step, if the hammer, hand assembly (including spring), or ratchet is damaged or broken, it will prevent the cylinder from rotating and aligning the next chamber with the barrel. If either the hand or ratchet is excessively worn, it will cause a timing issue. Either situation can be extremely dangerous. There is a possibility that the hammer can strike the primer of a cartridge that is slightly misaligned with the barrel.

If you suspect the hand or ratchet is broken, damaged, or worn, you can verify by watching and checking the cylinder. With an empty firearm, slowly set the hammer to the cocked position. Watch the cylinder as it rotates around the base pin and carefully listen for a "click" as the cylinder stop engages the cylinder before the hammer is fully cocked. Once the hammer is fully cocked, check the cylinder to verify it is locked in place. If the cylinder rotates slightly and you hear and feel the cylinder stop, you have a timing issue.

Once you have diagnosed the feeding problem, repairing feeding issues with a single-action revolver is as simple as replacing the broken, damaged, or worn parts and assemblies. If the firearm is excessively dirty, you will need to clean the parts/assemblies that are causing the malfunctions. This includes the cylinder, chambers and base pin, as well as the ratchet. Other parts that may need replacement would include the hammer/trigger and hand. Once the parts have been replaced, you will need to perform a function and safety check of the firearm to verify there is no timing issue. If the chambers do not feature a bevel/chamfer along their leading edge, you will need to form one. Once the firearm has been function and safety checked, you will need to test fire it.

Single-Action Revolver Locking Problems

The next type of malfunction you may experience with revolver actions would be a failure to lock. The locking step of a single-action revolver is accomplished when the hammer is set to the cocked position. As the hammer travels rearward, driving the hand into the ratchet and causing the cylinder to rotate around the base pin, the hammer will also drive the trigger so

that the sear surface of the trigger engages the hammer's hooks. As the trigger moves into position to trap the hammer, it will drive the cylinder stop upward (through linkage and spring force) so that it can engage the stop notch in the cylinder.

While the cylinder is rotating around the base pin, it brings the next chamber into alignment with the cylinder stop, and moves upward engaging a ramped section (lead) just ahead of the stop notch. The stop will ride the lead into the stop notch and arrest the cylinder's movement, aligning the chamber with the barrel. The stop should engage the notch and lock the cylinder slightly before the hammer is fully cocked.

If any part of the locking assembly or parts that drive the locking assembly become broken, damaged, or worn, the firearm may fail to lock. This includes the hammer, trigger, hand, spring, cylinder stop, ratchet or cylinder. If the hammer, trigger, or hand is broken, damaged, or worn, it may fail to drive the cylinder or cylinder stop or fail to drive the parts throughout their full travel. If the cylinder stop notch or the cylinder stop is damaged or worn, it may cause play in the cylinder or may allow the cylinder to unlock. If the spring that drives the cylinder stop is worn or damaged, it may also allow the cylinder to unlock.

Repairing locking malfunctions with single-action revolvers is as simple as replacing the broken, damaged, or worn parts. This includes the hammer, trigger, hand, cylinder stop or the cylinder itself. Once the damaged parts have been replaced, you will need to perform a function and safety check, as well as check the timing. If you must replace the cylinder, you will also have to perform a headspace check.

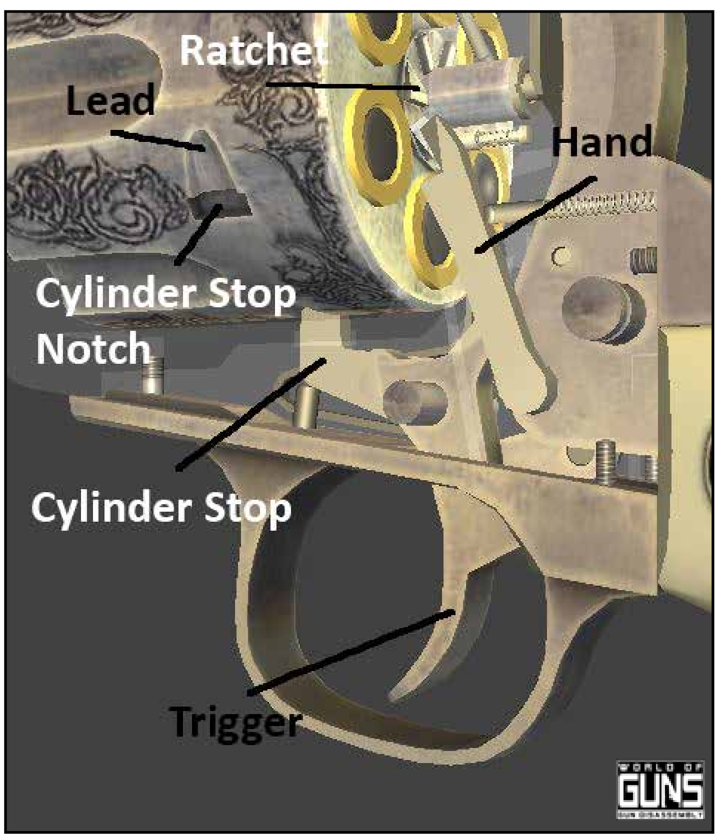

Figure 3: Parts of a single-action revolver locking assembly.

Single-Action Revolver Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. Because of the simplicity of the single-action revolver, there are only a few parts that can cause a failure to cock. When the operator drives the hammer backward and down (against the pressure of the mainspring) into the cocked position, the trigger spring will drive the trigger's sear surface, which is typically located on a tang on the rear of the trigger, into the path of the hammer's sear hooks, arresting the hammer's movement.

If any part of the FCG is broken, damaged, or worn, the revolver may fail to cock. If the sear surfaces on the trigger or hammer are broken or damaged, the hammer may fail to cock. If the sear surfaces are excessively worn, the hammer may cock temporarily and fall unintentionally if bumped or tapped. If the trigger spring is damaged or worn, it may fail to drive the trigger's sear surface into the path of the hammer's hooks. If the hammer strut is broken or damaged, it may not allow the hammer to move far enough back to reach the cocked position.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer, strut, hammer spring, trigger, and trigger springs. You may want to replace both sear surfaces (the trigger and hammer) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Single-Action Revolver Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. Depending on specific design, the firing step of a single-action revolver may vary slightly. The biggest difference between design types is the number of parts. Older guns tend to use less parts, while newer guns utilize more parts for safety and legal concerns.

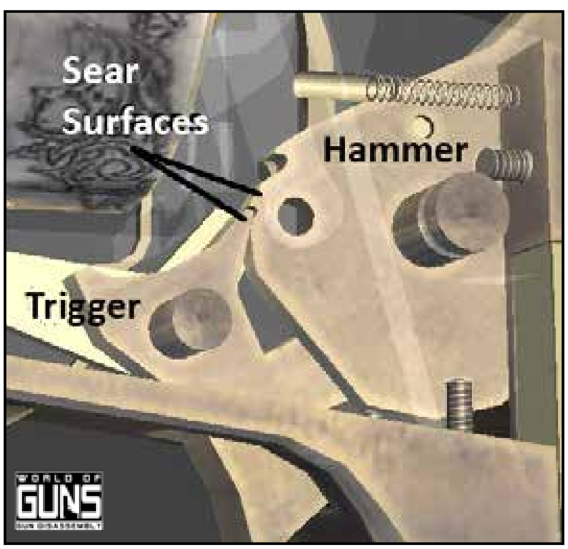

Figure 4: Sear surfaces of a single-action revolver.

Figure 5: Hammer with integral firing pin.

Figure 6: Separate hammer and firing pin.

Early single-action revolvers utilize a hammer that features an integral firing pin on its striking surface. When the trigger is pressed and begins to rotate around the trigger pin/screw, the sear surface of the trigger will slide across the hammer's hooks and free the hammer's movement. The hammer (driven by the hammer spring) will rotate around the hammer pin and the integral firing pin will contact the primer, firing the cartridge.

Later single-action revolver designs will utilize a multi-piece hammer/firing pin assembly. The hammer features a flat striking surface and the firing pin is located in the frame. When the trigger is pressed and the hammer is released, the hammer will strike the firing pin, driving it into the primer. The firing pin will typically feature a return spring, which will drive the firing pin backward as the action is unlocked.

Even newer single-action revolver designs will utilize a part known as a transfer bar. The transfer bar is used as a type of automated safety, which prevents accidental discharge. Unlike previous designs that could be dangerous if the hammer were to fall prematurely, designs that utilize a transfer bar are almost immune to accidental discharge.

Single-action revolvers that utilize a transfer bar will typically feature a lug on the frame or a recess on the hammer's face that will prevent the contact of the hammer and firing pin. When the trigger is pressed and begins to rotate around the trigger pin/screw, the transfer bar, which is linked to or activated by the trigger, will begin to rise into the path of the hammer. The transfer bar will move completely in front of the hammer before the hammer begins to move forward. The

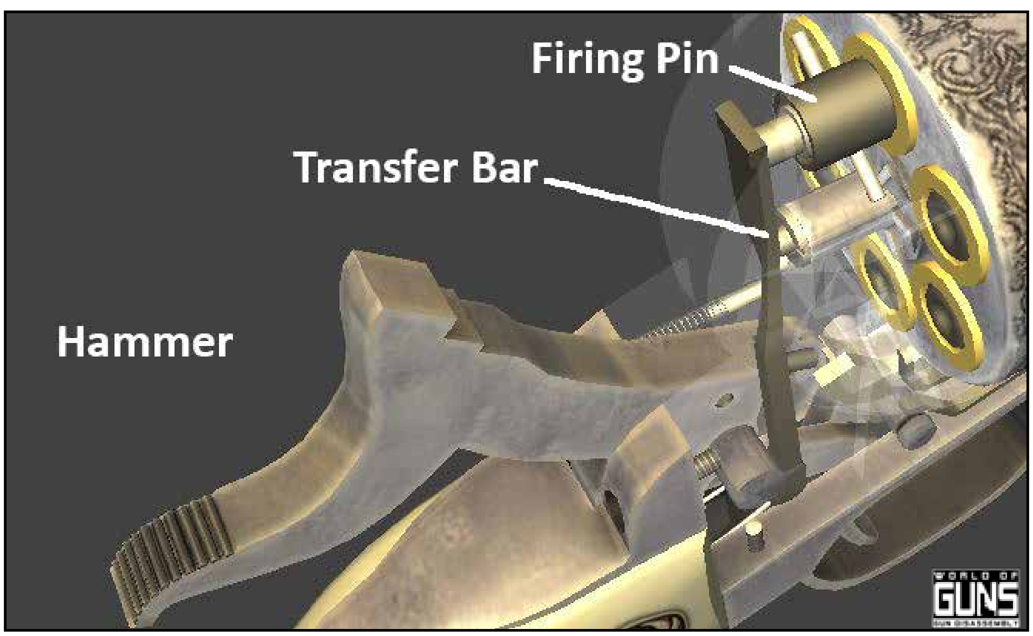

Figure 7: Single-action revolver transfer bar assembly.

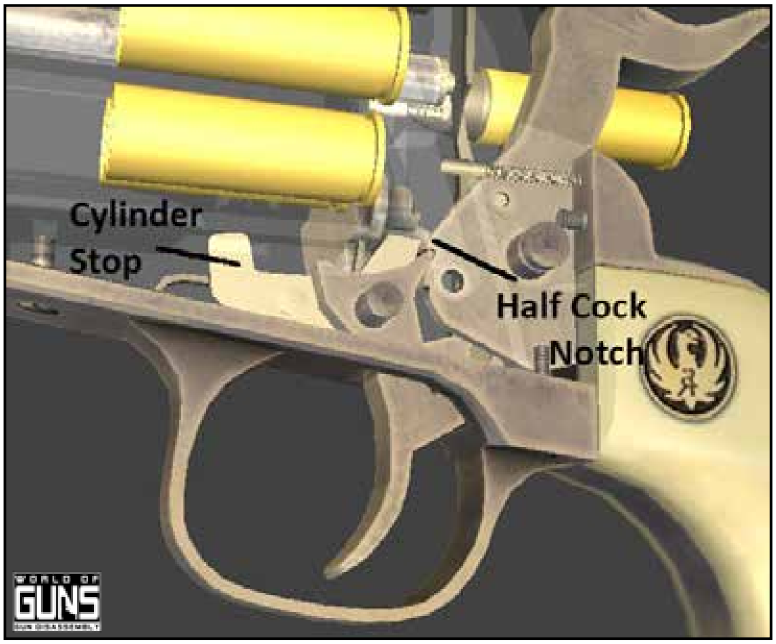

Figure 8: A single-action revolver's unlocking step.

hammer will strike the transfer bar, which will strike the firing pin and eventually the primer. If the hammer were to fall before the trigger is pressed (because of wear or parts breakage), the hammer would strike the lug on the frame and not contact the firing pin.

If any part of the FCG were to become broken, damaged, or worn, the revolver may experience failures to fire. The most likely cause of a failure to fire would be a worn or broken hammer spring or a damaged hammer. If the hammer spring is worn, it will not produce enough force to cause an adequate strike against the primer. If the spring, strut, hammer or transfer bar is broken, it may fail to contact the firing pin at all. Another cause of a failure to fire is a broken, damaged, or worn firing pin. Excessive dirt and debris inside the action may also lead to a failure to fire due to the extra friction in the action slowing the FCG parts.

Repairing failure to fire malfunctions with single-action revolvers is as simple as replacing the broken, damaged, or worn FCG parts or thoroughly cleaning the action. This includes the hammer, strut and hammer spring, transfer bar and firing pin. After you have replaced the parts (or cleaned the action), you will need to perform a function and safety check, followed by a test fire.

Single-Action Revolver Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. The unlocking step of a single-action revolver occurs after the cartridge has been fired and the trigger can reset. As the trigger moves forward (driven by the trigger return spring), linkage connected to the cylinder stop will pull it downward (against the cylinder stop spring), out of the path of the cylinder. The cylinder is now unlocked and the action is ready to feed, lock, and fire once more.

If any part of a single-action revolver that controls unlocking is excessively dirty or worn, or any parts are broken or damaged, it could cause the cylinder to fail to unlock. If the trigger or its linkage is broken or damaged, it may fail to drive the cylinder stop downward. If either the trigger return or cylinder stop spring is worn, it may fail to drive the respective parts and cause a failure to unlock.

Figure 9: The extraction/ejection step of a single-action revolver.

Repairing unlocking malfunctions with single-action revolvers is as simple as replacing the broken, damaged, or worn parts. This includes the trigger, cylinder stop, linkage and springs. You will need to perform a function and safety check once you have replaced the parts.

Single-Action Revolver Extracting and Ejecting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract and eject. With revolvers, the extraction and ejection steps are combined into a single step. The single-action revolver does not even utilize a traditional extractor, but rather an ejector rod that is used to push the empty cartridges from each individual chamber.

Once all the rounds have been fired, the operator must set the hammer to half-cock and open the loading gate so that he/she can begin to extract/eject the empty cases. Once the first chamber is aligned with the loading gate, the operator depresses the ejector rod by the ejector rod thumbpiece. The ejector rod will enter the front of the empty case and drive it out of the back of the cylinder. A return spring will drive the ejector rod back into its resting position. The operator must rotate the cylinder around the base pin until the next chamber is aligned with the loading gate. The operator must depress the ejector rod on each individual chamber until the cylinder is empty.

If the ejector rod were to become broken, damaged, or worn, it could lead to a failure to extract/eject. The ejector return spring could lead to a failure to extract/eject if it were to become jammed in the ejector rod channel/housing. Another cause of a failure to extract/eject would be excessively dirty or roughly machined chambers.

Repairing failure to extract/eject malfunctions is as simple as replacing the broken, damaged, or worn parts or assemblies. This includes the ejector rod assembly and return spring. If the chambers are roughly machined, you will need to polish the chambers as outlined earlier in this guide. Once the chambers have been polished, you will need to clean and lightly oil them.

Figure 10: The first stage of the feeding step of a double-action revolver.

Figure 11: The second stage of the feeding step of a double-action revolver.

DOUBLE-ACTION REVOLVERS

The double-action revolver design can be slightly more difficult to diagnose because of the increased number of parts and slightly more complex action. The double-action revolver differs from the single-action design in that the hammer can be cocked either by pressing the trigger or manually by the operator, unlike the single-action design, which can only be cocked manually. The first stage of the feeding process will also differ slightly.

Double-Action Revolver Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a double-action revolver action can experience would be failures to feed. Like the single-action, the feeding step of a double-action revolver is a two-phase process that involves both the action and the operator. The first stage of the feeding step of a double-action revolver involves depressing the cylinder release button. This frees the cylinder and allows it to swing away from the frame on a part called the crane/yoke. Once the cylinder has swung outward, away from the frame, the chambers are fully exposed and ready to load. The operator will load each chamber until the cylinder is full. Once the chambers are loaded, the operator closes the cylinder into the frame until it is trapped by the cylinder release. This is the end of the first stage of the loading process.

Once the cylinder has been loaded and locked into the frame, the second stage of the feeding process begins. This second stage of the process is semi-automated and is activated when the operator either cocks the hammer or presses the trigger (while the hammer is down). As the operator moves the hammer back and down into the cocked position, linkage on the hammer will activate the hand assembly (driving it up and forward under spring force), which will act upon the ratchet, causing the cylinder to rotate clockwise around the crane/yoke and bringing the first chamber into alignment with the barrel. Simultaneously, the cocking of the hammer will also force the trigger to drive the cylinder stop upward, locking the cylinder into alignment with the barrel. Pressing the trigger produces the same results as manually cocking the hammer. This is the end of the second stage of the feeding process.

Because the feeding step of a double-action revolver involves two separate stages, you must diagnose each stage separately. Beginning with the first stage, if the leading edge of the chamber is burred or does not feature a chamfer, it

may cause the cartridge to catch the edge of the chamber. If the cylinder release assembly is broken or damaged, it may fail to release the cylinder from the frame.

During the second stage of a double-action revolver's feeding step, if the hammer, hand assembly (including spring), or ratchet is damaged or broken, it will prevent the cylinder from rotating and aligning the next chamber with the barrel. If either the hand or ratchet is excessively worn, it will cause a timing issue. Either situation can be extremely dangerous. There is a possibility that the hammer can strike the primer of a cartridge that is slightly misaligned with the barrel.

If you suspect the hand or ratchet is broken, damaged, or worn, you can verify by watching and checking the cylinder. With an empty firearm, slowly set the hammer to the cocked position (or begin to press the trigger). Watch the cylinder as it rotates around the yoke and carefully listen for a "click" as the cylinder stop engages the cylinder before the hammer is fully cocked. Once the hammer is fully cocked, check the cylinder to verify it is locked in place. If the cylinder rotates slightly and you hear and feel the cylinder stop, you have a timing issue.

Once you have diagnosed the feeding problem, repairing feeding issues with a double-action revolver is as simple as replacing the broken, damaged, or worn parts and assemblies. If the firearm is excessively dirty, you will need to clean the parts/assemblies that are causing the malfunctions. This includes the cylinder, chambers, and crane/yoke, as well as the ratchet. Other parts that may need replacement would include the hammer/trigger and hand. Once the parts have been replaced, you will need to perform a function and safety check of the firearm to verify there is no timing issue. If the chambers do not feature a bevel/chamfer along their leading edge, you will need to form one. Once the firearm has been function and safety checked, you will need to test fire it.

Double-Action Revolver Locking Problems

The next type of malfunction you may experience with revolver actions would be a failure to lock. The locking step of a double-action

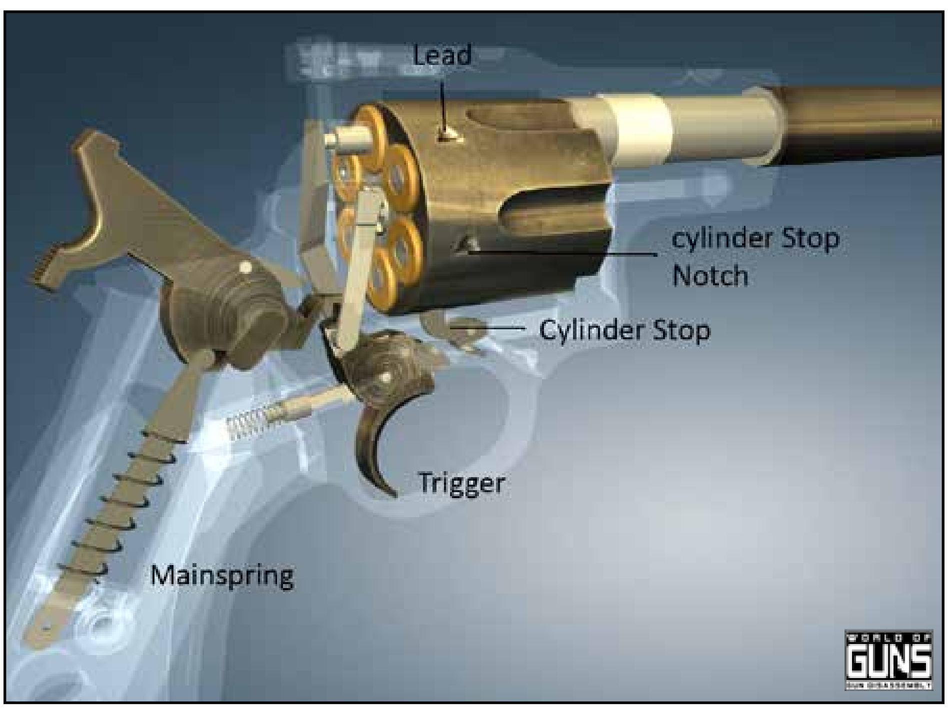

Figure 12: Parts of a double-action revolver locking assembly.

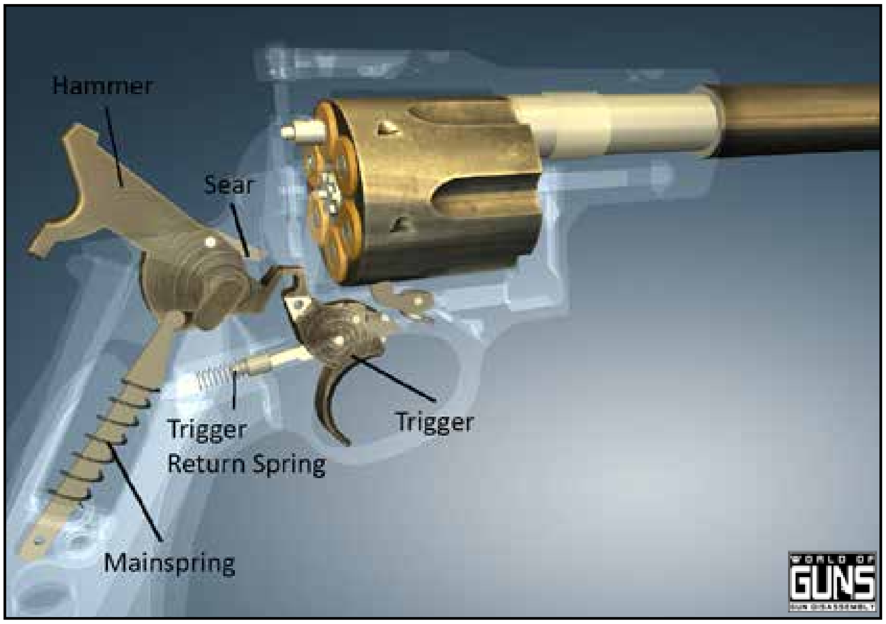

Figure 13: Double-action revolver cocking function in single-action.

revolver is accomplished when the hammer is set to the cocked position or when the hammer has nearly reached the end of its travel when the trigger is pressed. In single-action, as the hammer travels rearward, driving the hand into the ratchet and causing the cylinder to rotate around the crane/yoke, the hammer will also drive the trigger so that the sear surface of the trigger engages the hammer's hooks. As the trigger moves into position to trap the hammer, it will drive the cylinder stop upward (through linkage and spring force) so that it can engage the stop notch in the cylinder. In double-action, as the trigger is pressed, it will drive the hammer into the cocked position and (simultaneously) drive the hand and cylinder stop.

While the cylinder is rotating around the crane/yoke (bringing the next chamber into alignment), the cylinder stop moves upward, engaging a ramped section (lead) just ahead of the stop notch. The stop will ride the lead into the stop notch and arrest the cylinder's movement, aligning the chamber with the barrel. The stop should engage the notch and lock the cylinder slightly before the hammer is fully cocked.

If any part of the locking assembly or parts that drive the locking assembly become broken, damaged, or worn, the firearm may fail to lock. This includes the hammer, trigger, hand, spring, cylinder stop, ratchet, or cylinder. If the hammer, trigger, or hand is broken, damaged, or worn, it may fail to drive the cylinder or cylinder stop or fail to drive the parts throughout their full travel. If the cylinder stop notch or the cylinder stop is damaged or worn, it may cause play in the cylinder or may allow the cylinder to unlock. If the spring that drives the cylinder stop is worn or damaged, it may also allow the cylinder to unlock.

Repairing locking malfunctions with double-action revolvers is as simple as replacing the broken, damaged, or worn parts. This includes the hammer, trigger, hand, cylinder stop or the cylinder itself. Once the damaged parts have been replaced, you will need to perform a function and safety check, as well as check the timing. If you must replace the cylinder, you will also have to perform a headspace check.

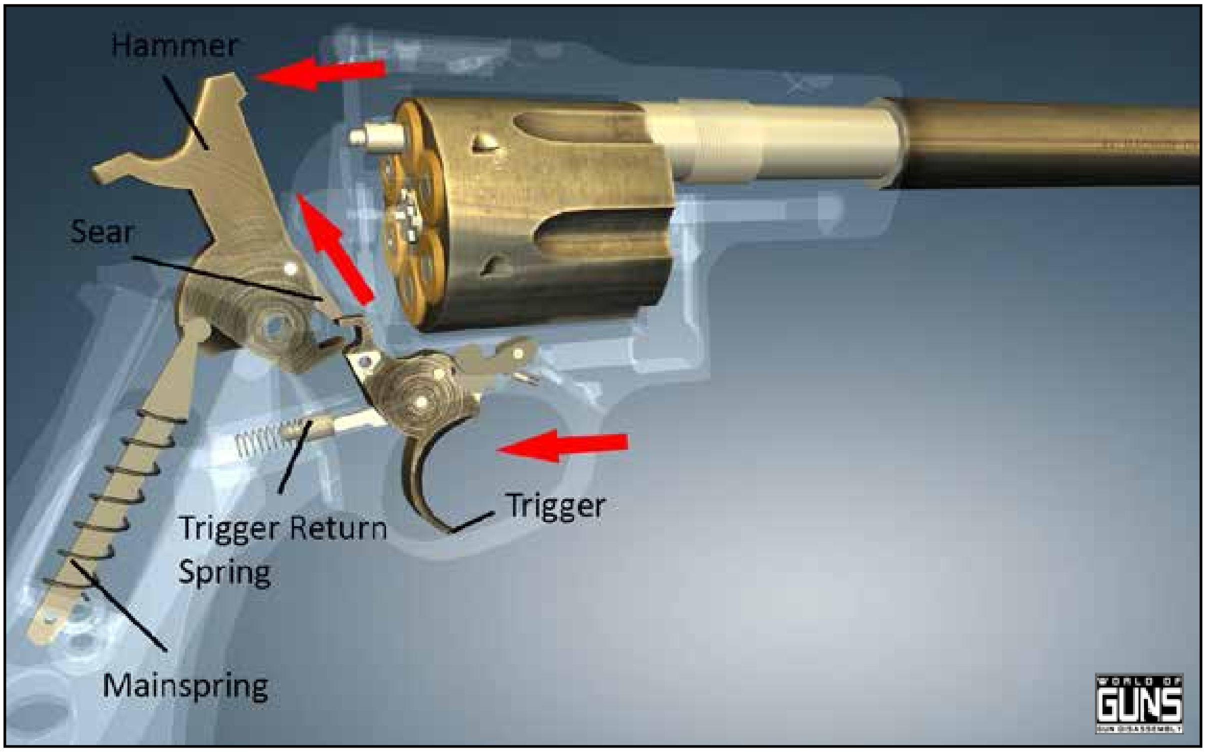

Figure 14: Double-action revolver cocking function in double-action.

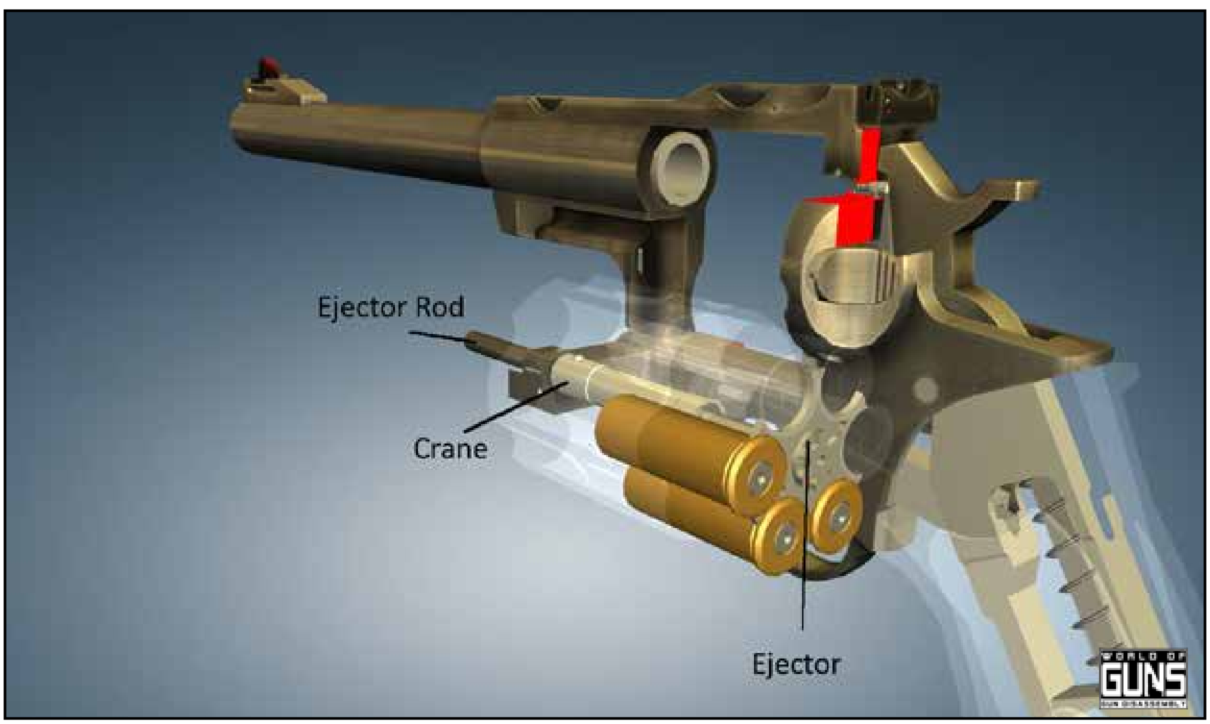

Figure 15: Double-action revolver ejector rod and ejector assembly.

Double-Action Revolver Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. The cocking step of a double-action revolver can be accomplished in one of two ways: manually by the operator (single-action) and automatically by pressing the trigger (double-action). While the hammer does not technically rest in the cocked position while being manipulated in double-action, it will momentarily reach the cocked position before immediately dropping. Different parts control each method of cocking, so you will need to understand each process. When the operator drives the hammer backward and down (against the pressure of the mainspring) into the cocked position, the hammer's hooks will begin to act upon a tang at the rear of the trigger, which will force the trigger around the trigger pin/screw. The trigger spring (or rebound slide) will drive the trigger's sear surface, which is typically located on a tang on the rear of the trigger, into the path of the hammer's sear hooks, arresting the hammer's movement.

When the operator presses the trigger, a tang at the rear of the trigger (where the sear surfaces are located) acts upon a part of the hammer assembly called the sear. As the trigger rotates around the trigger pin/screw, the rear tang of the trigger will push upward against the sear, which will drive the hammer back and down into the cocked position. The hammer will only be in the cocked position momentarily because as the trigger continues rearward through its stroke, it will release the hammer once it has reached full-cock. The sear is powered by a spring, which allows it to pivot out of the way when the trigger is reset.

If any part of the FCG is broken, damaged, or worn, the revolver may fail to cock. If either sear surfaces on the trigger or hammer are broken or damaged, the hammer may fail to cock. If the sear surfaces are excessively worn, the hammer may cock temporarily and fall unintentionally if bumped or tapped. If the trigger spring is damaged or worn, it may fail to drive the trigger's sear surface into the path of the hammer's hooks. If the hammer strut is broken or damaged, it may not allow the hammer to move far enough back to reach the cocked position.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer, strut, hammer spring, trigger and trigger springs. You may want to replace both sear surfaces (the trigger and hammer) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Double-Action Revolver Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. Like the single-action revolver, the firing sequence of the double-action revolver will vary slightly with design. With some designs, the firing pin is located on the hammer, and with others it is in the frame. Some designs also use transfer bars and others use hammer blocks.

With designs that utilize a firing pin in the hammer, when the operator presses the trigger and drives/releases the hammer, the hammer's firing pin will contact the primer directly and fire the cartridge. Newer variants of this design will incorporate a hammer block that will prevent the hammer from falling prematurely or unintentionally when the trigger has not been pressed. With designs that utilize a firing pin in the frame, when the operator presses the trigger and drives/releases the hammer, the hammer will fall onto the firing pin in the frame and drive it into the primer. Variants of this design will use a transfer bar between the hammer and firing pin

to prevent accidental discharge if the hammer were to fall when the trigger is not being pressed.

If any part of the FCG were to become broken, damaged, or worn, the revolver may experience failures to fire. The most likely cause of a failure to fire would be a worn or broken hammer spring or a damaged hammer. If the hammer spring is worn, it will not produce enough force to cause an adequate strike against the primer. If the spring, strut, hammer or transfer bar is broken, it may fail to contact the firing pin at all. If the hammer block is broken or damaged, it may fail to clear the path of the hammer and prevent it from contacting the primer. Another cause of a failure to fire is a broken, damaged, or worn firing pin. Excessive dirt and debris inside the action may also lead to a failure to fire due to the extra friction in the action slowing the FCG parts.

Repairing failure to fire malfunctions with double-action revolvers is as simple as replacing the broken, damaged, or worn FCG parts or thoroughly cleaning the action. This includes the hammer, strut and hammer spring, transfer bar, hammer block, and firing pin. After you have replaced the parts (or cleaned the action), you will need to perform a function and safety check, followed by a test fire.

Double-Action Revolver Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. The unlocking step of a double-action revolver occurs after the cartridge has been fired and the trigger can reset. As the trigger moves forward (driven by the trigger return spring), linkage connected to the cylinder stop will pull it downward (against the cylinder stop spring), out of the path of the cylinder. The cylinder is now unlocked and the action is ready to feed, lock, and fire once more.

If any part of a double-action revolver that controls unlocking is excessively dirty or worn, or any parts are broken or damaged, it could cause the cylinder to fail to unlock. If the trigger or its linkage is broken or damaged, it may fail to drive the cylinder stop downward. If either the trigger return or cylinder stop spring is worn, it may fail to drive the respective parts and cause a failure to unlock.

Figure 16: Cylinder gap.

Repairing unlocking malfunctions with double-action revolvers is as simple as replacing the broken, damaged, or worn parts. This includes the trigger, cylinder stop, linkage and springs. You will need to perform a function and safety check once you have replaced the parts.

Double-Action Revolver Extracting and Ejecting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract and eject. Like the single-action revolver, the double-action revolver combines the extraction and ejection steps into one sequence. The double-action revolver does not even feature a traditional ejector.

Once all the cartridges have been fired, the operator depresses the cylinder release and swings the cylinder out, away from the frame to expose the chambers. The operator will then depress the extractor rod, which will drive the extractor into the rim of the cartridge cases. The extractor will push all the cases from the chambers simultaneously. Using gravity, all the empty cases will fall from the chambers. The extractor return spring will force the extractor back into the cylinder in preparation for loading.

If the extractor rod or extractor were to become broken, damaged, or worn, it could lead to a failure to extract/eject. The extractor return spring could lead to a failure to extract/eject if it were to become jammed in the crane/yoke. Another cause of a failure to extract/eject would be excessively dirty or roughly machined chambers.

Repairing failure to extract/eject malfunctions is as simple as replacing the broken, damaged, or worn parts or assemblies. This includes the extractor rod, extractor assembly, and return spring. If the chambers are roughly machined, you will need to polish the chambers as outlined earlier in this guide. Once the chambers have been polished, you will need to clean and lightly oil them.

Figure 17: Pressure release from cylinder gap.

CYLINDER GAP

There is one more issue that may arise with both single- and double-action revolvers. Regardless of action design or type, there must be a small amount of clearance between the cylinder and barrel of a revolver for proper function. This allows the cylinder to move freely without binding. This space is called the cylinder gap. Depending on design and caliber, the gap may range from .003 in. to .013 in.

When the cartridge is discharged and the bullet is forced from the case and through the throat of the cylinder, it must jump from the cylinder,

through the gap, and into the forcing cone of the barrel. When the projectile passes from the cylinder to the barrel, a considerable amount of hot, high pressure gas is released from the gap.

If the cylinder gap were to grow beyond the manufacturer's original specifications, it could lead to a dangerous situation where large amounts of hot, high pressure gas and possibly fragments of bullets can injure the operator. If the gap is too large, there is a chance for misalignment, which could lead to the bullet shaving across the inside edge of the barrel's forcing cone. Over time, the cylinder's contact with the frame and barrel can lead to enough wear to open the gap (which could also lead to a headspace issue).

Often, the only real fix to an excessive cylinder gap is to replace and re-index a new barrel. This involves removing the old barrel from the frame and machining the new barrel so that it is within factory specs. When the new barrel is installed, it must be screwed down until its shoulder bottoms out against the frame. If the barrel is not indexed correctly after torqueing, you will need to cut the shoulder back until the barrel is indexed correctly. Once the barrel is indexed, you will need to check the cylinder gap. If the gap is too small, you will need to cut the breech face of the barrel to the correct size. If the gap is too large, you will need to cut the shoulder back and start the process over.

A least likely fix may be as simple as replacing the cylinder or ratchet assembly. Because of manufacturer variances, you may be able to find a slightly longer cylinder that will close the gap. Anytime you replace the cylinder you will need to perform a headspace check. After either the barrel or cylinder is replaced, you will need to perform a function and safety check as well as a test fire.

REVOLVER ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Feed	1. Broken, damaged, or worn parts including the cylinder, ratchet, hammer, hand, and cylinder release or springs. 2. A roughly machined or undersized chamber(s).	1. Replace broken, damaged, or worn parts. 2. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Lock	1. Broken, damaged, or worn parts, including the hammer, trigger, cylinder stop, spring or cylinder.	1. Replace broken, damaged, or worn parts.
Failure to Cock	1. Broken, damaged, or worn sear surfaces. Broken or damaged FCG parts, including the strut and springs.	1. Replace worn or damaged parts. Some sear surfaces can be dressed and polished.
Failure to Fire	1. Broken, damaged, or worn FCG parts, including the hammer, strut, spring, transfer bar and firing pin. 2. Excessive dirt and debris inside the action.	1. Replace broken, damaged, or worn parts. 2. Thoroughly clean and lightly oil the action.
Failure to Unlock	1. Broken, damaged, or worn unlocking parts or assemblies, including the trigger, return spring, cylinder stop and cylinder stop spring.	1. Replace broken, damaged, or worn parts.
Failure to Extract/Eject	With Single-Action Revolvers: 1. Broken, damaged, or worn ejection parts, including the ejector rod and return spring. 2. Roughly machined chambers. With Double-Action Revolvers: 1. Broken, damaged, or worn extraction parts, including the extractor rod, extractor and return spring. 2. Roughly machined chambers.	With Single-Action Revolvers: 1. Replace broken, damaged, or worn parts. 2. Polish and lightly oil the chambers. With Double-Action Revolvers: 1. Replace broken, damaged, or worn parts. 2. Polish and lightly oil the chambers.

NOTES

Troubleshooting Blowback Actions

Unlike all the previous actions that have been discussed, the blowback action is completely reliant on ammunition and operator technique for proper function. The blowback design also presents unique challenges because the action does not truly lock like every other action design. To make things even more complicated, there are many variants of the blowback design that use various mechanical means to try to delay the "unlocking" or opening of the action. The two blowback action types are straight blowback and delayed blowback.

The major difference between the two blowback actions occurs during the locking and unlocking stages; feeding, cocking, firing, extracting

Figure 1: The feeding step of a tubular magazine-fed blowback action.

and ejecting will all be similar. With straight blowback actions, the only things that hold the breech closed during discharge are the weight of the bolt/slide and the inertia of the action/recoil spring. The straight blowback action is designed for low power cartridges like rimfire and small centerfire pistol rounds. With delayed blowback actions, various mechanical means, such as rollers, levers, gas, friction or toggles, as well as the weight of the parts and inertia of the action/recoil spring, are used to slow the "unlocking" or opening of the breech after discharge. The delayed blowback action is designed for more powerful cartridges, such as centerfire bottleneck rifle rounds.

Because the breech does not lock and the only thing driving the action is the energy that is created by the cartridge, diagnosing blowback actions can be tricky. Underpowered cartridges or improper shooting technique can both lead to malfunctions with blowback actions. Once ammunition and operator error are ruled out, you can focus on the firearm itself.

Blowback Action Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a blowback action firearm can experience would be failures to feed. Because of the function of the action, blowback firearms are always magazine-fed. Depending on the specific model, the firearm may be fed by a fixed (tubular) magazine or by a fixed or detachable box magazine. Each specific feed type will feature a different feeding sequence and will have different parts to diagnose.

Regardless of feed type, the initial step in the feeding process of blowback firearms is the same. With a fully loaded magazine, an empty

chamber and a closed breech, the operator manipulates the bolt/charging handle or slide. As the operator drives the bolt/charging handle/slide to the rear of the action, it will begin to compress the action/recoil spring.

With tubular magazine-fed blowback actions, as the action continues rearward, the bolt will trip the elevator/lifter, which will begin to move downward in preparation for feeding. As the bolt continues rearward, either the bolt or elevator/lifter will trip a cartridge release/stop that will allow one round from the magazine to enter the breech and onto the elevator lifter. Once the operator has reached the end of the bolt's stroke, the action/recoil spring will be fully compressed and ready to drive it forward.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle, allowing the action to move forward under spring force. The action/recoil spring will drive the bolt forward. As the bolt moves forward, it will trip the elevator/lifter and force it upward, bringing the cartridge into alignment with the bolt. As the bolt continues forward, it will begin to push the cartridge from the elevator/lifter and drive it into the chamber. The bolt will continue forward until it has bottomed out against the breech face of the barrel, which is fixed in place.

With box magazine-fed (fixed and detachable) blowback actions, as the action continues rearward, the bolt/slide will pass over the top cartridge in the magazine (pushing it downward slightly) and continue rearward until it has reached the end of its rearward stroke. Once the bolt/slide has reached the end of its rearward travel, the action/recoil spring will be fully compressed and ready to drive the action forward again.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle/slide, allowing the action to move forward under spring force. As the bolt/slide moves forward, a lug (typically the cocking lug) on the bottom of the bolt/slide will contact the head of the cartridge case and begin to drive it from the magazine. The bolt will continue forward, driving the round from the magazine until it has bottomed out against the breech face of the barrel, which is fixed in place.

Regardless of the feed device type, once the bolt/slide has bottomed out against the barrel, the round has been fully fed into the chamber. If any one of the parts that controls the feeding

Figure 2: The feeding step of a box magazine-fed blowback action.

step becomes broken, damaged, or worn, it may lead to a failure to feed. This includes the magazine (tubular or box) assembly, elevator/lifter (tubular magazine firearms only), the bolt/slide, or the action/recoil spring assembly. If the magazine assembly is broken, damaged, or worn, it may allow too many cartridges into the breech at once, or may fail to even feed a single round. If the elevator/lifter is broken, damaged, or worn, it may fail to raise the round into the path of the bolt. If the lug on the bolt/slide is broken, damaged, or worn, it may fail to drive the round from the magazine or may cause misalignment of the round as it moves toward the chamber. If the action/recoil spring assembly is broken, damaged, or worn, it may fail to drive the bolt/slide with enough force to fully chamber the cartridge. Two less likely (but still possible) causes of a failure to feed would be a roughly machined or undersized chamber or excessive dirt and debris.

Repairing failure to feed malfunctions with blowback firearms is as simple as replacing the broken, damaged, or worn parts. This includes the magazine assembly (body, spring and follower), elevator/lifter (tubular magazine firearms only), bolt/slide, action/recoil spring and chamber. If you must replace the bolt/slide, you will need to perform a headspace check. If the issue is caused by a short or rough chamber, you will need to polish or recut the chamber to SAAMI specs. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate the chamber. Once you have replaced parts, you will need to perform a function and safety check, followed by a test fire.

Blowback Action Locking Problems

The next type of malfunction you may experience with blowback action firearms would be a failure to lock. Because of the simplicity of the straight blowback design, the moment the bolt/slide bottoms out against the barrel, the breech is fully "locked." There is no locking lug engagement, no bolt turning, no locking mechanisms, only the bolt/slide touching the barrel. The only thing keeping the breech closed is the action/recoil spring, even with designs that utilize a mechanical means of delaying the breech's opening.

When delayed blowback actions "lock," all that is holding the breech closed is the action/recoil spring. The delaying mechanism will "preload"

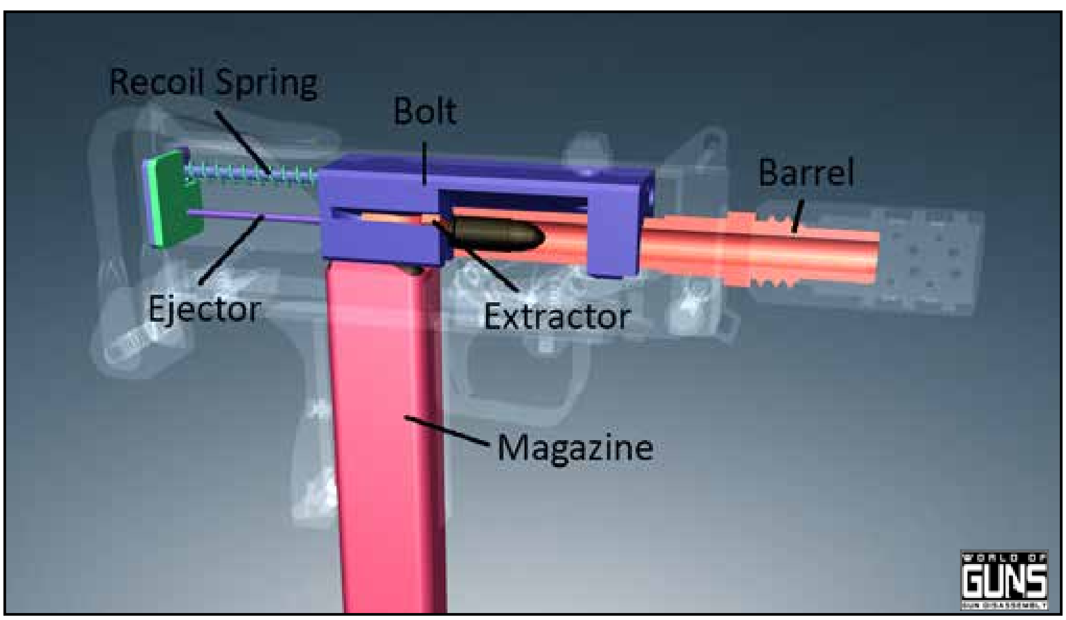

Figure 3: A locked straight blowback action.

as the action closes in preparation for discharge, but does not technically lock. The delaying mechanism only affects the unlocking step in the COO, but can disturb the locking step if the parts are malfunctioning.

If any part of the assemblies that control locking were to become broken, damaged, or worn, the action may fail to lock. The primary reason any blowback action would fail to lock would be a broken, damaged, or worn action/recoil spring assembly. If there is an issue with the action/recoil spring assembly, it may fail to drive the bolt/slide with enough force to feed the round into the chamber and bottom out against the barrel. The next possible cause of a locking malfunction with blowback firearms would be excessive dirt and debris in the action and chamber. Because straight blowback actions are often chambered in rimfire calibers, which typically produce a lot of fouling, they are more likely to experience a malfunction caused by excessive friction. Another cause of a failure to lock would be the extractor. If the extractor is broken or damaged, it may fail to jump over the rim of the cartridge and the breech may not fully close. With delayed blowback actions, if any part or assembly that is used to slow the action becomes broken, damaged, worn, or excessively dirty, it may create excessive friction in the action or cause the action to seize. This includes roller, lever and toggle assemblies. Blowback actions are also susceptible to locking malfunctions caused by rough or undersized chambers.

Repairing failure to lock malfunctions with blowback firearms is as simple as replacing the broken, damaged, or worn parts. This includes the action/recoil spring assembly, extractor or delaying assemblies. If the action and chamber are excessively dirty, you will need to thoroughly clean and lightly lubricate the action and chamber. If the chamber is rough or undersized, you will need to polish or recut the chamber.

Figure 4: Blowback action cocking.

Blowback Action Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. The cocking step of a blowback firearm occurs automatically when the action cycles after a cartridge has been discharged. The cocking step also occurs when the operator charges the firearm, loading the first cartridge into the empty chamber. With blowback actions, the cocking step may occur with either a hammer or striker. An addition of a part known as the disconnector will also introduce another factor when diagnosing issues.

With hammer-fired models, when the operator loads the firearm in preparation for firing, as they pull the charging handle/slide to the rear of the action, an integral cocking lug on the underside of the bolt/slide will contact the striking face of the hammer and begin to drive it back and downward into the cocked position. Simultaneously, if the operator is still holding the trigger, the bolt slide will trip the

disconnector, allowing it to trap the hammer. If the operator has released the trigger, the hammer will be trapped by the sear or trigger, fully cocked and ready to fire. The bolt/slide will continue rearward until it reaches the end of its rearward stroke and slams forward under action/recoil spring force.

With striker-fired models, when the operator loads the firearm, as the action moves backward, the bolt/slide will carry the striker with it. Simultaneously, if the operator is still holding the trigger, the bolt/slide will trip the disconnector, allowing the sear to move into position to trap the striker. If the operator has released the trigger, the sear will already be in position, ready to trap the striker. The bolt/slide will continue rearward until it reaches the end of its rearward stroke and slam forward under action/recoil spring force. As the bolt/slide travels forward, the striker will be trapped by the sear, fully cocked and ready to fire.

When the operator fires the round, the energy created during discharge will drive the bolt/slide rearward once more, cocking the hammer/striker. Each time a round is fired, the action will cycle and cock the hammer/striker. This cycle will continue until the magazine is empty.

If any part or assembly that controls cocking becomes broken, damaged, or worn, it may lead to a failure to cock. Because of the design of the blowback action, ammunition and the operator can both contribute to cocking malfunctions in the form of short-stroking. Short-stroking occurs with blowback actions when the cartridge fails to produce enough energy to drive the action completely through its stroke. It will also occur when the operator fails to hold the firearm with enough force to prevent it from recoiling excessively, causing the energy used to cycle the action to dissipate.

Once you have ruled out ammunition and operator error as possible causes for malfunction, you can focus on the remainder of the action. The most likely cause of a failure to cock malfunction would be damage or wear to the FCG parts, including the hammer/striker, hammer strut, trigger, sear, disconnector and respective springs. If the sear surfaces are worn or damaged, the hammer/striker may only cock temporarily before prematurely falling. If the

Figure 5: Blowback action FCG parts.

hammer strut or hammer or striker spring is damaged or broken, the hammer/striker may fail to cock at all.

A less likely but still possible cause of a failure to cock would be the action/recoil spring. If the action/recoil spring is broken or damaged, it may not allow the action to travel far enough to the rear of its travel to fully cock the hammer/striker. Excessive dirt and debris inside the action can also lead to a failure to cock if the fouling produces enough friction to slow the cycling action. A dirty or roughly machined chamber can also create enough friction to slow the action and cause a failure to cock.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer/striker, strut, hammer spring, sear, sear spring, disconnector, disconnector spring, trigger and trigger springs. You may want to replace both sear surfaces (the sear and hammer/striker) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Blowback Action Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. Like other action types, failure to fire malfunctions with blowback actions can be contributed to one assembly: the FCG. The firing step will vary slightly depending on if the system is hammer- or striker-fired.

If the firearm utilizes a hammer assembly, when the operator presses the trigger and releases the hammer, it will fall and contact the firing pin. The firing pin will lunge forward, striking the primer and discharging the round. If the firearm utilizes a striker assembly, when the operator presses the trigger, the sear will release the striker, allowing it to lunge forward and strike the primer.

If any part of the FCG becomes broken, damaged, or worn, the firearm may experience a failure to fire. The most likely cause of failures to fire with blowback actions would be broken or damaged firing pins/strikers or worn hammers or striker springs. If the firing pin or striker is damaged or broken, it may fail to create an indentation on the primer or may make an indentation that is too shallow. If the hammer or striker spring is worn or broken, it may not drive the hammer/striker quickly enough to strike the primer hard enough.

A few less likely but still possible causes would be long chamber or long headspace or excessive dirt and debris inside the FCG. Because of the allowable tolerances of the chamber, firing pin/striker and cartridge, if the chamber is on the long side and the ammunition is on the short side, the firing pin/striker may not be able to create a deep enough depression in the primer. If the FCG is excessively dirty, it may create enough friction to slow the hammer and firing pin or striker enough to create a light strike.

Repairing failure to fire malfunctions with blowback firearms is as simple as replacing the broken, damaged, or worn parts. This includes the hammer/striker, hammer spring, striker spring, firing pin or other parts of the FCG that may interfere with the firing step. If the FCG is excessively dirty, you will need to thoroughly clean and lightly lubricate the parts. If the issue is caused by a long chamber, you may need to replace the barrel or the bolt slide. If you do replace the barrel or bolt/slide, you will need to perform a headspace check. Once you have replaced the parts, you will need to perform a function and safety check, followed by a test fire.

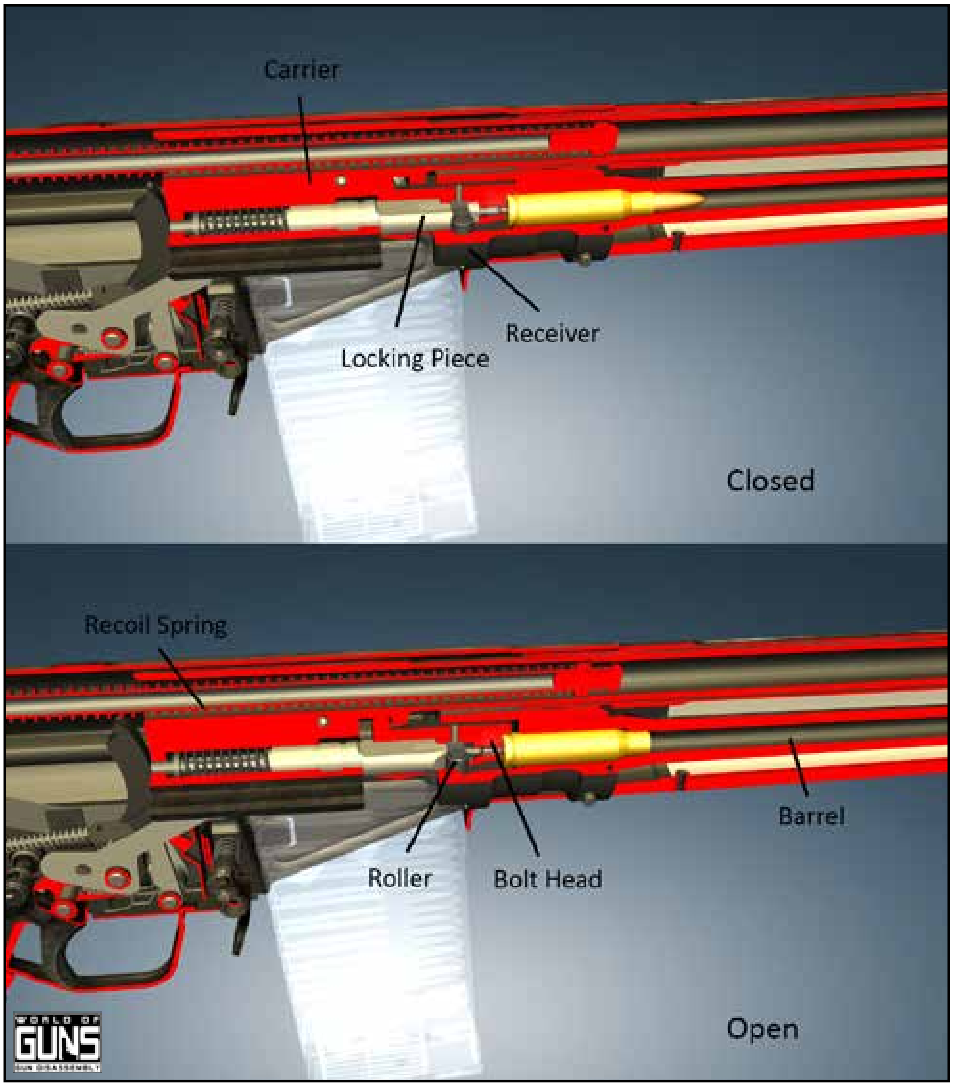

Figure 6: Roller delayed action opening.

Blowback Action Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. If the firearm utilizes a straight blowback action, the unlocking step is extremely simple. The moment the cartridge is discharged, the high pressure gas that pushes the bullet from the firearm begins to push backward against the cartridge case. The pressure begins to drive the case rearward, which forces the bolt/slide back. The moment the bolt/slide and barrel are separated, the breech is "unlocked" or open.

If the firearm utilizes a delayed blowback action, the unlocking step may be difficult to diagnose because of the added complexity of the delaying device. Because the devices used to delay the "unlocking" or opening of the breech can vary greatly, diagnosing issues may be challenging if you do not fully understand how the action works. For the purposes of this guide, we will focus on the three most popular means of action delaying: roller, lever, and gas.

With roller delayed actions, when the round is discharged and the case begins to push against the bolt, the bolt will begin to move backward. As the bolt moves backward, it will contact the

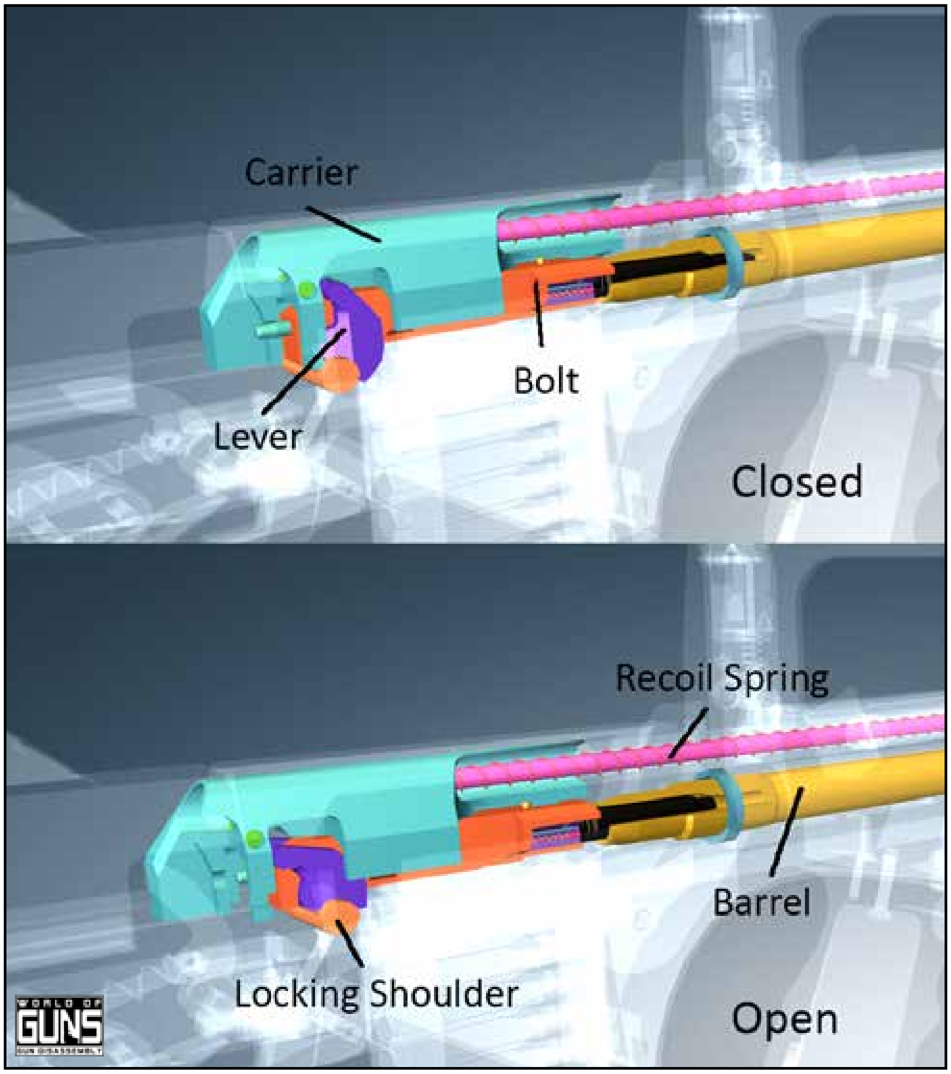

Figure 7: Lever delayed action opening.

rollers, which will force the bolt carrier back at a greater velocity than the bolt, slightly delaying the opening of the breech. As the bolt carrier moves backward, after a short distance, the carrier will begin to pull the bolt with it, "unlocking" the breech.

With lever delayed actions, when the round is discharged and the case begins to push against the bolt, the bolt will begin to move backward. As the bolt moves backward, it will begin to move the lever with it. Almost instantly, the short arm (resistance arm) of the lever will bottom out against a leverage surface or the receiver. The lever will begin to rotate, driving the long arm (effort arm) into the bolt carrier and forcing it backward at a greater velocity than the bolt, slightly delaying the opening of the breech. As the bolt carrier moves backward, after a short distance the carrier will begin to pull the bolt with it, "unlocking" the breech.

With gas delayed actions, when the round is discharged and the case begins to push against the slide, the slide will begin to move backward. A port just ahead of the chamber will bleed high

pressure gas into a chamber under the barrel. The tapped gas will act upon a piston that is affixed to the slide, which will delay the slide's movement, slightly delaying the opening of the breech. Once the bullet has exited the muzzle, the pressure inside the bore and chamber will dissipate, allowing the slide to move backward with no (extra) resistance.

If any part or assembly that is associated with unlocking becomes broken, damaged, or worn, the firearm may fail to unlock. This includes the action/recoil spring, chamber, bolt/slide and delaying device, if applicable. The most likely cause of an unlocking malfunction with blowback firearms would be a damaged or broken action, or recoil spring. If the spring or spring assembly is damaged, it may not allow the breech to open. If the chamber is roughly machined or excessively dirty, it may create so much friction between the empty case and chamber walls that it dissipates the energy trying to force the case and action backward. If the bolt or slide becomes damaged or broken, it may create so much friction within the receiver or along the slide rails that it does not unlock after discharge. If the action utilizes a device to delay the action's opening, or if any part or assembly of the delaying device is broken, damaged, or worn, it may cause the action to bind and fail to open.

Repairing unlocking malfunctions with blowback firearms is as simple as replacing the broken, damaged, or worn parts. This includes the action/recoil spring, barrel, bolt/slide or delaying device, if applicable. If the chamber is rough or excessively dirty, you will need to polish and thoroughly clean and lightly lubricate it. If you must replace the barrel or bolt/slide, you will need to perform a headspace check. After you have replaced any part, you will need to perform a function and safety check, followed by a test fire.

Blowback Action Extracting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract. Like other steps in a blowback action's COO, the extracting step can be affected by ammunition and improper operator technique. Once ammunition or operator error has been ruled out, you can focus on the firearm.

When the cartridge is discharged and the high pressure gas in the chamber and bore begin to push against the bolt/slide, an extractor affixed to the bolt/slide will immediately begin pulling the case from the chamber. As the bolt/slide begins moving backward, the extractor's claw will grab the rim of the empty case. As the high pressure gas continues to drive the bolt/slide

Figure 8: Blowback action extracting.

Figure 9: Blowback action ejecting.

rearward, it will continue to drag the empty case from the chamber.

If any part or assembly that controls extracting becomes broken, damaged, or worn, the firearm may experience failure to extract. The most likely cause of extraction malfunctions would be a broken, damaged, or worn extractor or extractor spring. If the extractor or spring is damaged or worn, it may not grab the rim of the case or may slip over the rim prematurely. If the action/recoil spring is broken or damaged, it may not allow the action to travel back far enough for the extractor to remove the case from the chamber. If the chamber is dirty or rough or the action is excessively dirty, it may create so much friction that the action does not complete its rearward stroke and fails to extract the case from the chamber.

Repairing extraction malfunctions with blowback actions is as simple as replacing the broken, damaged, or worn parts. This includes the extractor, extractor spring or action/recoil spring. If the chamber is rough, you will need to polish the chamber and thoroughly clean and lightly lubricate it. If the chamber is roughly machined, you will need to polish the chamber and thoroughly clean and lightly lubricate it. Once you have replaced parts, you will need to perform a function and safety check.

Blowback Action Ejecting Problems

The last type of malfunction that may occur would be a failure to eject. Like other steps of a blowback action's COO, the ejection step can be affected by ammunition and improper operator technique. Once ammunition and operator error have been ruled out as a cause of ejection malfunctions, you can focus on the remainder of the firearm.

After discharge, as the action moves rearward, the extractor will pull the empty case into the ejector. As the empty case contacts the ejector, it will begin to rotate around the extractor and out of the ejection port. Most blowback actions utilize an ejector that is affixed to the frame because a sprung or powered ejector (located in the bolt face or slide) would force the action out of battery and would not allow the breech to close completely.

If any part or assembly that controls ejecting becomes broken, damaged, or worn, the firearm may experience failure to eject. The most likely cause of a failure to eject would be the ejector itself. If the ejector is broken, damaged, or worn, when the empty case impacts the ejector, it may fail to exit the breech or become jammed in the action. The firearm may also experience erratic ejection and possibly eject cases directly at the operator. If the action/recoil spring or assembly is damaged, it may not allow the action to travel far enough backward to complete ejection. If the chamber is rough or excessively dirty, it may create so much friction that the action cannot eject the case completely.

Repairing ejection malfunctions with blowback firearms is as simple as replacing the broken, damaged, or worn parts. This includes the ejector and action/recoil spring. If the chamber is rough, you will need to polish and thoroughly clean it. If the action or chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate it.

BLOWBACK ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Feed	1. Broken, damaged, or worn feed parts, including the magazine assembly, elevator/lifter, bolt/slide or action/recoil spring. 2. A roughly machined or undersized chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Lock	1. Broken, damaged, or worn action/recoil spring assembly. 2. Excessive dirt and debris in the action and chamber. 3. Broken or damaged extractor. 4. Broken or damaged delaying parts, including roller, lever and toggle assemblies. 5. A roughly machined or undersized chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Thoroughly clean and lightly lubricate the action and chamber. 3. Replace the extractor assembly. 4. Replace broken, damaged, or worn parts or assemblies. 5. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Cock	1. Broken, damaged, or worn FCG parts, including the hammer/striker, sear, disconnector, trigger or springs. 2. Broken, damaged, or worn action/recoil spring assembly. 3. Excessive dirt and debris in the action or chamber. 4. Roughly machined chamber.	1. Replace worn or damaged parts. Some sear surfaces can be dressed and polished. 2. Replace broken, damaged, or worn parts. 3. Thoroughly clean and lightly lubricate the action. 4. Polish, then clean and lightly oil the chamber.

BLOWBACK ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Fire	1. Broken, damaged, or worn FCG parts, including the hammer/firing pin, striker and springs. 2. Long chamber/headspace. 3. Excessive dirt and debris in the FCG.	1. Replace broken, damaged, or worn parts. 2. Replace the barrel or bolt/slide. 3. Thoroughly clean and lightly lubricate the action.
Failure to Unlock	1. Broken or damaged action/recoil spring or bolt/slide. 2. Excessively rough or dirty chamber. 3. Broken, damaged, or worn delaying assembly.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber. 3. Replace broken, damaged, or worn parts.
Failure to Extract	1. Broken, damaged, or worn parts including the extractor, extractor spring or action/recoil spring. 2. Excessively rough or dirty chamber.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber.

Troubleshooting Recoil-Operated Actions

Like the blowback action, recoil-operated firearms rely on the energy created by the discharging cartridge to cycle the action. But unlike the blowback action, recoil-operated firearms utilize a locking breech. Recoil-operated actions also are not driven directly by the pressure created by the cartridge, but rather by the energy of the recoiling barrel and action parts.

Figure 1: The feeding step of a tubular magazine-fed recoil-operated action.

INERTIA-OPERATED, LONG RECOIL AND SHORT RECOIL ACTIONS

There are three basic recoil-operated designs: long and short recoil and inertia-operated. One thing that all three action types share is the fact that the barrel will move with the action to some degree. The movement of the barrel is what drives the remainder of the action. You will need to have a thorough understanding of the function of the recoil-operated systems and the nuances of each action design. Although all recoil-operated firearms function in the same basic manner, each individual design will vary slightly in its means.

Recoil Operation Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a recoil-operated firearm can experience would be failures to feed. Because of the function of the action, recoil-operated firearms are always magazine-fed, with the exception of the Browning M2, which is belt-fed. Depending on the specific model, the firearm may be fed by a fixed (tubular) magazine or by a fixed or detachable box magazine. Each specific feed type will feature a different feeding sequence and will have different parts to diagnose.

Regardless of feed type, the initial step in the feeding process of recoil-operated firearms is the same. With a fully loaded magazine, an empty chamber and a closed breech, the operator manipulates the bolt/charging handle or slide. As the operator drives the bolt/charging handle/slide to the rear of the action, it will begin to compress the action/recoil spring.

With tubular magazine-fed recoil-operated actions, as the action continues rearward, the bolt will trip the elevator/lifter, which will begin to move downward in preparation for feeding. As the bolt continues rearward, either the bolt or elevator/lifter will trip a cartridge release/stop that will allow one round from the magazine to enter the breech and onto the elevator lifter. Once the operator has reached the end of the bolt's stroke, the action/recoil spring will be fully compressed and ready to drive it forward.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle, allowing the action to move forward under spring force. The action/recoil spring will drive the bolt forward. As the bolt moves forward, it will trip the elevator/lifter and force it upward,

bringing the cartridge into alignment with the bolt. As the bolt continues forward, it will begin to push the cartridge from the elevator/lifter and drive it into the chamber. The bolt will continue forward until it has contacted the barrel, driving it forward and locking the round in the chamber.

With long recoil actions, the feeding step will vary depending on if the round is being fed during loading or discharge. When loading the first round, the loading step will be similar to other tubular magazine-fed actions when the action is cycling. After the first round is fired and the action cycles to the rear, the bolt will remain trapped at the rear of the action with the empty case while the barrel begins to travel forward. As the barrel travels forward, an ejector assembly, which is affixed to the barrel, will kick the case from the breech. When the barrel reaches its forward-most position, it will trip the cartridge release and elevator lifter, which will rise into the path of the bolt. Also, when the barrel reaches its forward-most position, it will release the bolt, which will be driven forward by the action/recoil spring. The bolt will strip the round from the elevator/lifter and drive it into the chamber.

With box magazine-fed (fixed and detachable) recoil-operated actions, as the action continues rearward, the bolt/slide will pass over the top cartridge in the magazine (pushing it downward slightly) and continue rearward until it has reached the end of its rearward stroke. Once the bolt/slide has reached the end of its rearward travel, the action/recoil spring will be fully compressed and ready to drive the action forward again.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle/slide, allowing the action to move forward under spring force. As the bolt/slide moves forward, a lug (typically the cocking lug) on the bottom of the bolt/slide will contact the head of the cartridge case and begin to drive it from the magazine. The bolt will continue forward, driving the

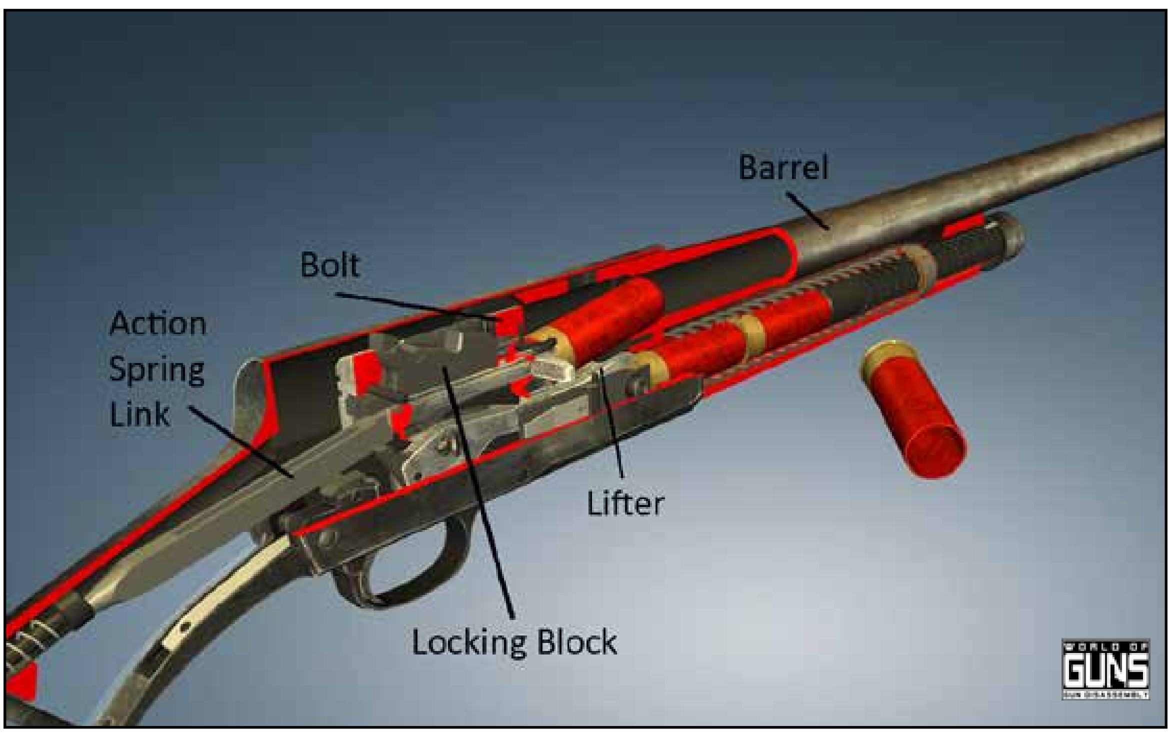

Figure 2: The feeding step of a long recoil action firearm.

Figure 3: The feeding step of a box magazine-fed recoil-operated action.

round from the magazine until it has entered the chamber. The bolt/slide will continue driving the cartridge forward until it has contacted the barrel, driving the barrel and the action forward until the breech locks.

Regardless of the feed device type, once the bolt/slide has locked up with the barrel, the round has been fully fed into the chamber. If any one of the parts that controls the feeding step becomes broken, damaged, or worn, it may lead to a failure to feed. This includes the magazine (tubular or box) assembly, elevator/lifter (tubular magazine firearms only), the bolt/slide or the action/recoil spring assembly. If the magazine assembly is broken, damaged, or worn, it may allow too many cartridges into the breech at once, or may fail to even feed a single round. If the elevator/lifter is broken, damaged, or worn, it may fail to raise the round into the path of the bolt. If the lug on the bolt/slide is broken, damaged, or worn, it may fail to drive the round from the magazine or may cause misalignment of the round as it moves toward the chamber. If the action/recoil spring assembly is broken, damaged, or worn, it may fail to drive the bolt/slide with enough force to fully chamber the cartridge. Two less likely (but still possible) causes of a failure to feed would be a roughly machined or undersized chamber or excessive dirt and debris.

Repairing failure to feed malfunctions with recoil-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the magazine assembly (body, spring and follower), elevator/lifter (tubular magazine firearms only), bolt/slide, action/recoil spring and chamber. If you must replace the bolt/slide,

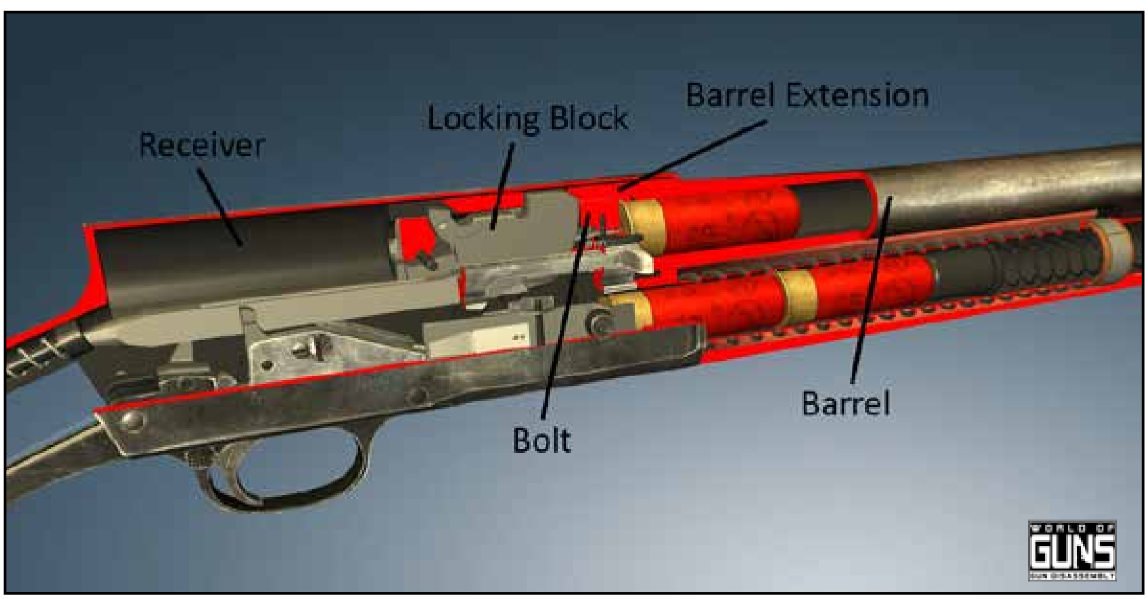

Figure 4: Long recoil action locking.

you will need to perform a headspace check. If the issue is caused by a short or rough chamber, you will need to polish or recut the chamber to SAAMI specs. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate the chamber. Once you have replaced parts, you will need to perform a function and safety check, followed by a test fire.

Recoil Operation Locking Problems

The next type of malfunction you may experience with recoil-operated firearms would be a failure to lock. Every recoil-operated firearm utilizes a true locking breech design, but the locking step will vary with each specific action. We will discuss the locking step with the three major recoil action types (long, short, and inertia) and several specific designs.

With long recoil actions, as the bolt is traveling forward under action/recoil spring force, the barrel will already be in its forward-most position. The bolt will strip the round from the elevator/lifter and drive it into the chamber. The bolt will bottom out against the barrel, tripping the locking block located in the center of the bolt, which will pivot upward into a recess in the barrel's extension. The locking block's engagement with the barrel extension will lock the bolt against the barrel.

With short recoil actions, as the slide moves forward under action/recoil spring force, the barrel will be retracted (backward) from its locked position. Depending on the specific design of the action, the barrel may be tilted, rotated, or inline from its locked position. As the slide continues forward, it will strip a round from the magazine and drive it into the chamber. When the slide contacts the barrel (driving the round completely in the chamber), it will begin to drive the barrel forward. As the slide and barrel move forward together, the barrel will begin to move into its locked position. Depending on the specific design of the action, the barrel may pivot (muzzle down), rotate, or simply move forward into its locked position. When the barrel has reached the end of its forward stroke and the locking lugs on the barrel (or locking block) and slide are fully engaged, the breech is fully locked and ready for discharge.

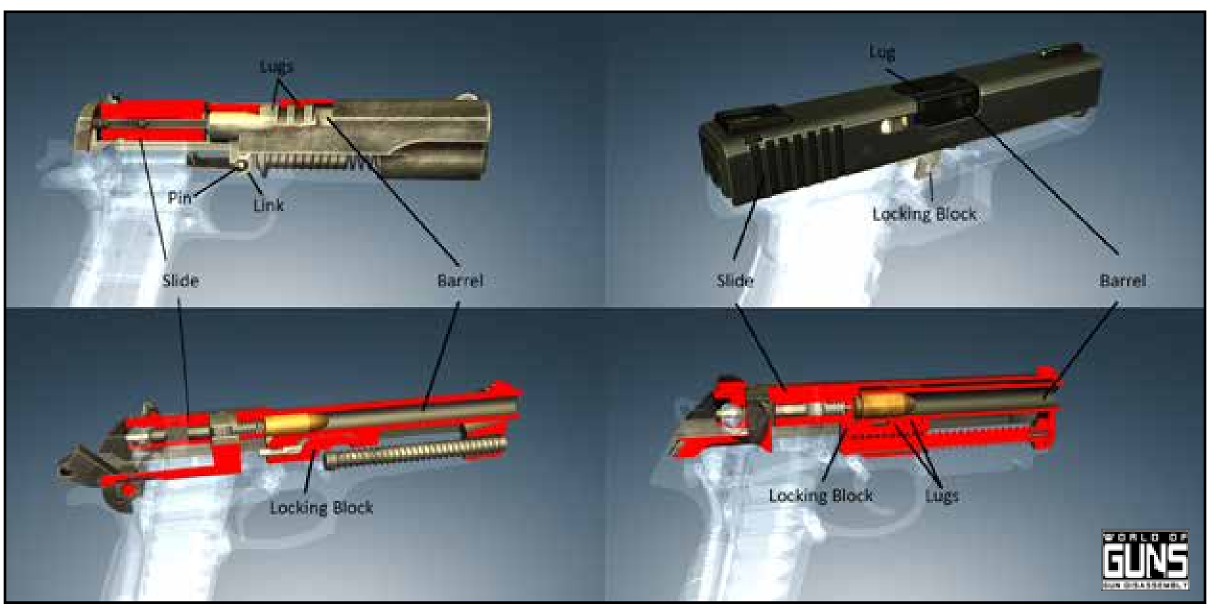

Figure 5: Short recoil action locking.

INERTIA, LONG AND SHORT RECOIL ACTIONS

With inertia-operated actions, as the bolt moves forward under action/recoil spring force, the barrel will be retracted (backward) from its locked position. The bolt will strip the round from the elevator/lifter and drive it into the chamber. The bolt will bottom out against the barrel while the bolt carrier continues forward. A slot in the carrier will guide a cam pin located in the bolt to force the bolt to rotate as the carrier continues forward. When the bolt begins to rotate, the lugs of the bolt will engage lugs on the barrel extension. The carrier will continue forward and continue to rotate the bolt until it bottoms out against the barrel. Once the carrier has bottomed out against the bolt, the locking lugs will be fully engaged and the breech will be fully locked.

If any part or assembly that controls locking is broken, damaged, or worn, the firearm may fail to completely lock. With long recoil actions, if the bolt, locking block, or barrel extension is broken or damaged, the locking lugs may fail to engage or may not engage completely. If the lug on the locking block or the recess of the barrel extension is worn, it may allow the breech to unlock prematurely. With short recoil actions, if the slide, barrel, or (depending on model) locking block, link, barrel pin or barrel bushing is broken or damaged, it may not allow the breech to fully lock. If the locking lugs on the barrel or slide are worn, they may allow the breech to unlock prematurely. With inertia-operated actions, if the bolt, carrier, cam pin, inertia spring (located between the bolt and carrier), or barrel extension is broken or damaged, it may not allow the breech to fully lock. If the locking lugs on the bolt and barrel extension are worn, they may allow the breech to unlock prematurely.

The action/recoil spring may also cause locking malfunctions. If the spring is broken, damaged, or worn, it may not drive the action hard enough to lock the breech completely. Recoil-operated actions are also susceptible to locking malfunctions caused by excessive dirt and debris. Excessive friction will slow the action enough to prevent the breech from fully locking. A short or rough chamber can also lead to locking malfunctions.

Figure 6: Inertia-operated action locking.

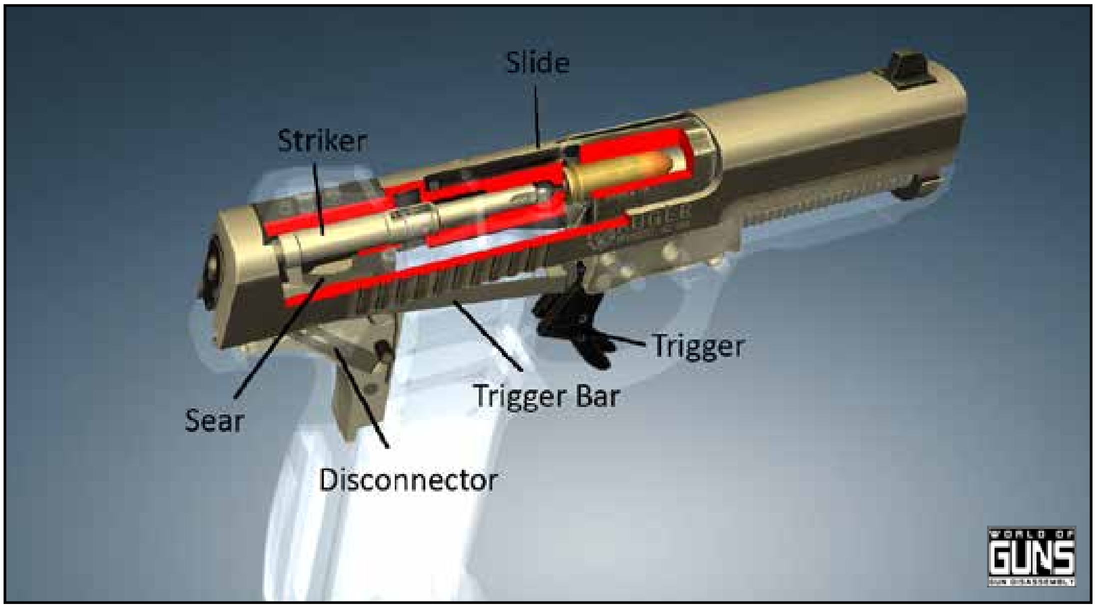

Figure 7: Recoil-operated action cocking.

Repairing failure to lock malfunctions with recoil-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the bolt/slide, barrel/extension, locking block, link, bushing or action/recoil spring. If the action and chamber are excessively dirty, you will need to thoroughly clean and lightly lubricate the action and chamber. If the chamber is rough or undersized, you will need to polish or recut the chamber.

Recoil Operation Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. The cocking step of a recoil-operated firearm occurs automatically when the action cycles after a cartridge has been discharged. The cocking step also occurs when the operator charges the firearm, loading the first cartridge into the empty chamber. With recoil-operated actions, the cocking step may occur with either a hammer or striker. The addition of a part known as the disconnector will also introduce another factor when diagnosing issues.

With hammer-fired models, when the operator loads the firearm in preparation for firing, as they pull the charging handle/slide to the rear of the action, an integral cocking lug on the underside of the bolt/slide will contact the striking face of the hammer and begin to drive it back and downward into the cocked position. Simultaneously, if the operator is still holding the trigger, the bolt slide will trip the disconnector, allowing it to trap the hammer. If the operator has released the trigger, the hammer will be trapped by the sear or trigger, fully cocked and ready to fire. The bolt/slide will continue rearward until it reaches the end of its rearward stroke and slams forward under action/recoil spring force.

With striker-fired models, when the operator loads the firearm, as the action moves backward, the bolt/slide will carry the striker with it. Simultaneously, if the operator is still holding the trigger, the bolt/slide will trip the disconnector, allowing the sear to move into position to trap the striker. If the operator has released the trigger, the sear will already be in position, ready to trap the striker. The bolt/slide will continue rearward until it reaches the end of its rearward stroke and slams forward under action/recoil spring force. As the bolt/slide travels

forward, the striker will be trapped by the sear, fully cocked and ready to fire.

When the operator fires the round, the energy created during discharge will drive the bolt/slide rearward once more, cocking the hammer/striker. Each time a round is fired, the action will cycle and cock the hammer/striker. This cycle will continue until the magazine is empty.

If any part or assembly that controls cocking becomes broken, damaged, or worn, it may lead to a failure to cock. Because of the design of the recoil-operated action, ammunition and the operator can both contribute to cocking malfunctions in the form of short-stroking. Short-stroking occurs with blowback actions when the cartridge fails to produce enough energy to drive the action completely through its stroke. It will also occur when the operator fails to hold the firearm with enough force to prevent it from recoiling excessively, causing the energy used to cycle the action to dissipate.

Once you have ruled out ammunition and operator error as possible causes for malfunction, you can focus on the remainder of the action. The most likely cause of a failure to cock malfunction would be damage or wear to the FCG parts, including the hammer/striker, hammer strut, trigger, sear, disconnector and respective springs. If the sear surfaces are worn or damaged, the hammer/striker may only cock temporarily before prematurely falling. If the hammer strut or hammer or striker spring are damaged or broken, the hammer/striker may fail to cock at all.

A less likely but still possible cause of a failure to cock would be the action/recoil spring. If the action/recoil spring is broken or damaged, it may not allow the action to travel far enough to the rear of its travel to fully cock the hammer/striker. Excessive dirt and debris inside the action can also lead to a failure to cock if the fouling produces enough friction to slow the cycling action. A dirty or roughly machined chamber can also create enough friction to slow the action and cause a failure to cock.

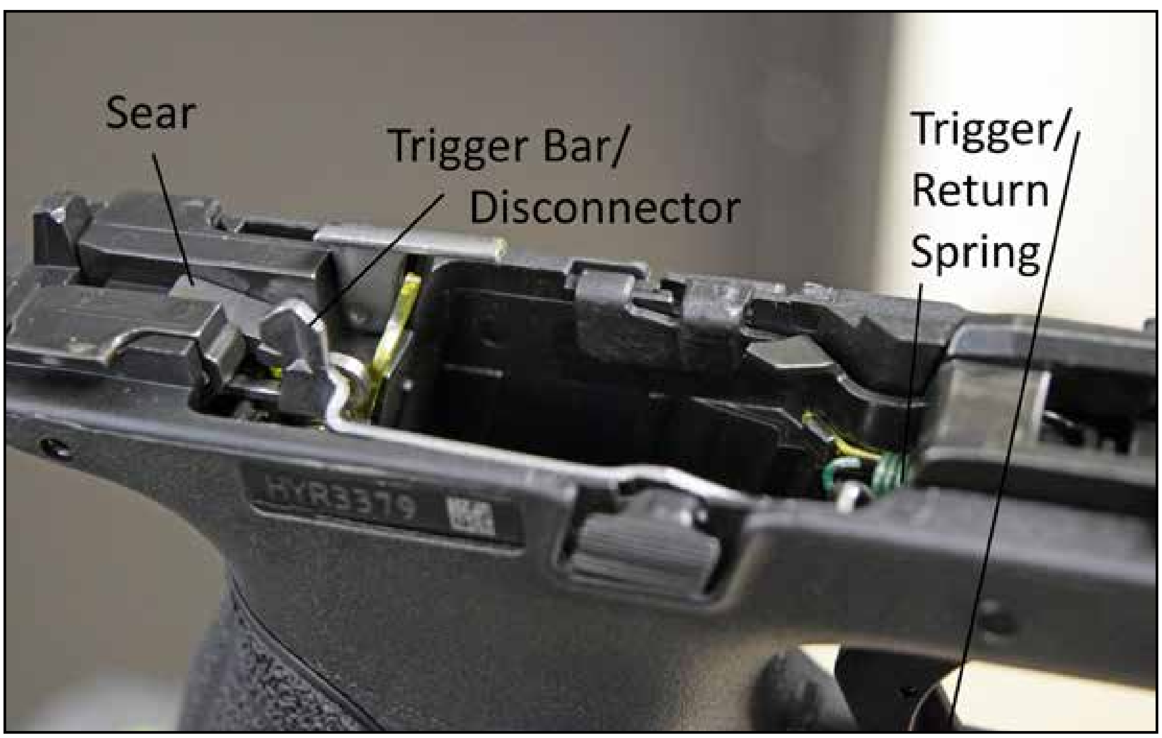

Figure 8: Recoil operated action FCG parts.

Figure 9: Recoil-operated action hammer and striker assemblies.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer/striker, strut, hammer spring, sear, sear spring, disconnector, disconnector spring, trigger and trigger springs. You may want to replace both sear surfaces (the sear and hammer/striker) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Recoil Operation Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. Like other action types, failure to fire malfunctions with recoil-operated actions can be contributed to one assembly: the FCG. The firing step will vary slightly depending on if the system is hammer- or striker-fired.

If the firearm utilizes a hammer assembly, when the operator presses the trigger and releases the hammer, it will fall and contact the firing pin. The firing pin will lunge forward, striking the primer and discharging the round. If the firearm utilizes a striker assembly, when the operator presses the trigger, the sear will release the striker, allowing it to lunge forward and strike the primer.

If any part of the FCG becomes broken, damaged, or worn, the firearm may experience a failure to fire. The most likely cause of failures to fire with recoil-operated actions would be a broken or damaged firing pin/striker or a worn hammer or striker spring. If the firing pin or striker is damaged or broken, it may fail to create an indentation on the primer or may make an indentation that is too shallow. If the hammer or striker spring is worn or broken, it may not drive the hammer/striker quickly enough to strike the primer hard enough.

A few less likely but still possible causes would be a long chamber or long headspace or excessive dirt and debris inside the FCG. Because of the allowable tolerances of the chamber, firing pin/striker and cartridge, if the chamber is on the long side and the ammunition is on the short side, the firing pin/striker may not be able to create a deep enough depression in the primer. If the FCG is excessively dirty, it may create enough friction to slow the hammer and firing pin or striker enough to create a light strike.

Repairing failure to fire malfunctions with recoil-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the hammer/striker, hammer spring, striker spring, firing pin or other parts of the FCG that may interfere with the firing step. If the FCG is excessively dirty, you will need to thoroughly clean and lightly lubricate the parts. If the issue is caused by a long chamber, you may need to replace the barrel or the bolt slide. If you do replace the barrel or bolt/slide, you will need to perform a headspace check. Once you have replaced the parts, you will need to perform a function and safety check, followed by a test fire.

Recoil Operation Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. The unlocking step will vary with each specific action design but will begin the exact same way. When the operator presses the trigger and discharges

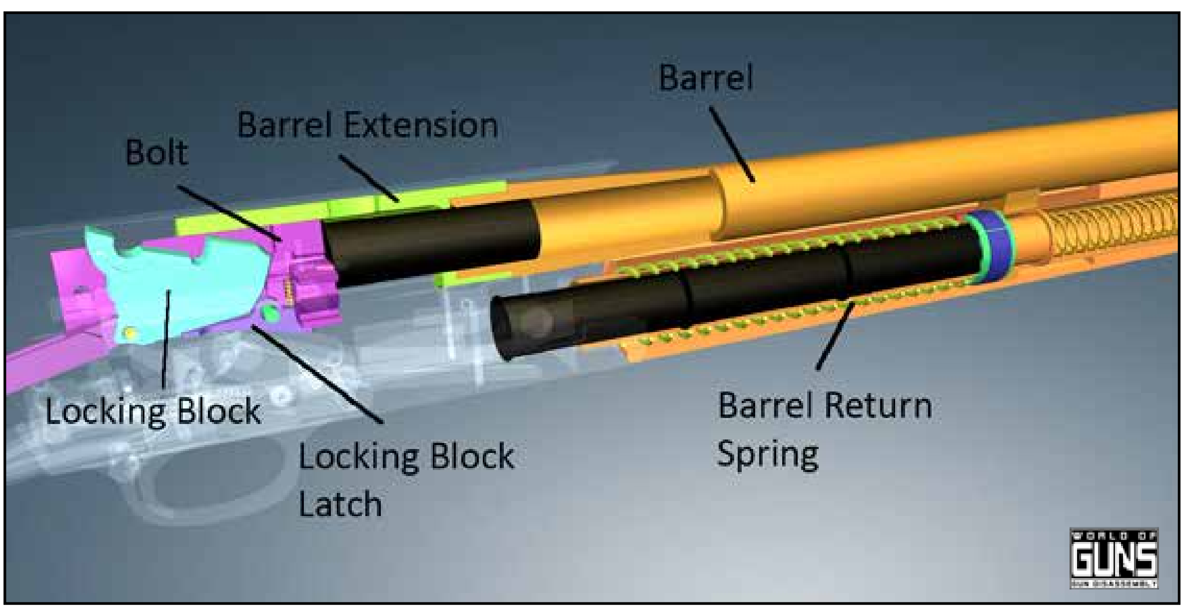

Figure 10: Long recoil action unlocking.

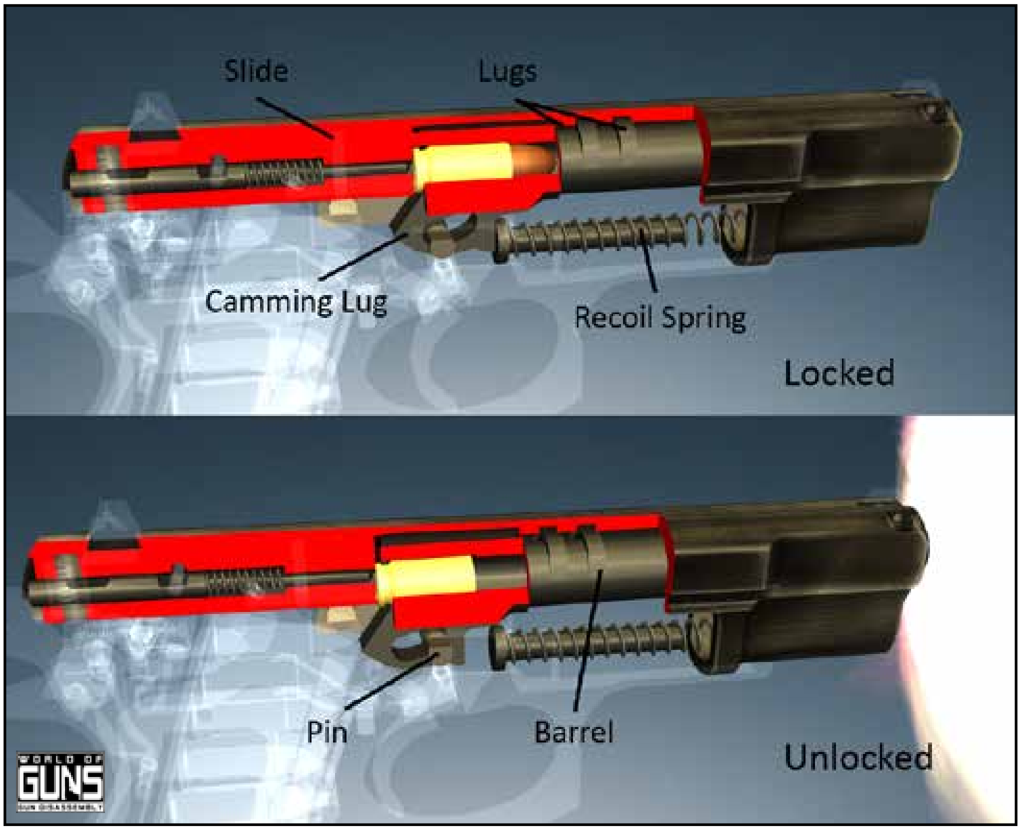

Figure 11: Tilting barrel action unlocking.

the cartridge, the energy created during discharge will force the bullet from the bore and force the barrel and action rearward. The barrel and bolt/slide (being locked together) will move backward under recoil energy. This is where the similarities between recoil-operated actions end.

With long recoil actions, as the bolt and barrel continue backward under recoil energy (still locked together), the cocking lug on the bolt will cock the hammer. The bolt and barrel will continue rearward (locked together) until the bolt has bottomed out against the rear of the receiver. Once the bolt has reached the end of its stroke, three things will happen. An assembly will capture the bolt, trapping it to the rear of the receiver. Another assembly will trip the locking block, causing it to rotate and release its lugs from the barrel extension's recess. And once the bolt has been captured and the locking block has released the barrel, a return spring will drive the barrel (and empty case) forward into its resting position.

With short recoil actions, as the slide and barrel continue backward under recoil energy, the barrel will be arrested while the slide continues rearward. Depending on the specific design of the action, the barrel may be arrested by a locking block, pin, or link, which will cause the barrel to tilt, rotate, or remain inline. Tilting barrel actions use an array of mechanical devices to accomplish locking and unlocking. Some designs utilize camming lugs of the barrel and locking block to force the barrel to tilt, which will cause the locking lugs on the barrel and slide to disengage. Other designs will use a link and pin to pull the breech end of the muzzle downward to unlock the action.

Designs that rotate will utilize a camming lug on the barrel, which will ride in a channel in the locking block. During unlocking, the barrel will move backward a short distance as the camming lug travels the channel in the locking block. The channel will force the barrel to rotate, which will free the barrel's locking lugs from the slide, allowing the slide to continue to move rearward.

Actions that utilize an inline locking system will use a locking block that surrounds the barrel and rides along a locking pin. During discharge, the barrel, slide, and locking block will all move backward together. A cutout in the locking block will force it downward as it moves across the locking pin. The lugs on the locking block will clear the lugs on the slide and allow the slide to continue rearward while the locking block restrains the barrel.

With inertia-operated actions, as the barrel and bolt travel rearward (still locked together), the spring between the bolt and carrier will begin to compress. The barrel and bolt will cease their rearward movement as the inertia spring begins to drive the carrier backward at a higher rate of velocity than the barrel/bolt. The channel in the carrier will force the bolt to rotate as the carrier moves backward. Once the lugs of the bolt clear the lugs on the barrel extension, the bolt and carrier will continue through their rearward stroke.

Regardless of the specific action type, once the locking lugs of the barrel/extension and slide/bolt have disengaged and the barrel and bolt/slide separate, the action is unlocked. If any part or assembly that controls unlocking becomes broken, damaged, or worn, the firearm may fail to unlock. This includes the barrel, bolt/slide, locking block, or any other part that is utilized

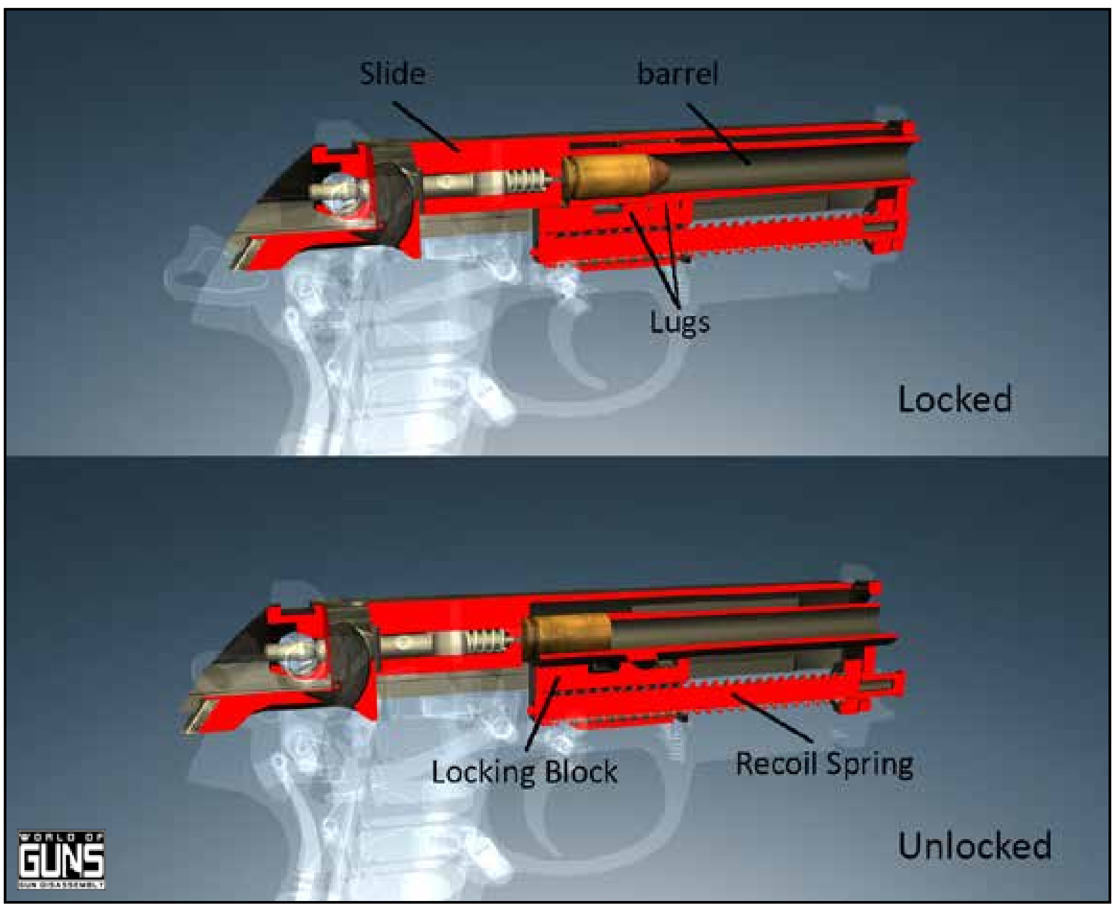

Figure 12: Rotating barrel action unlocking.

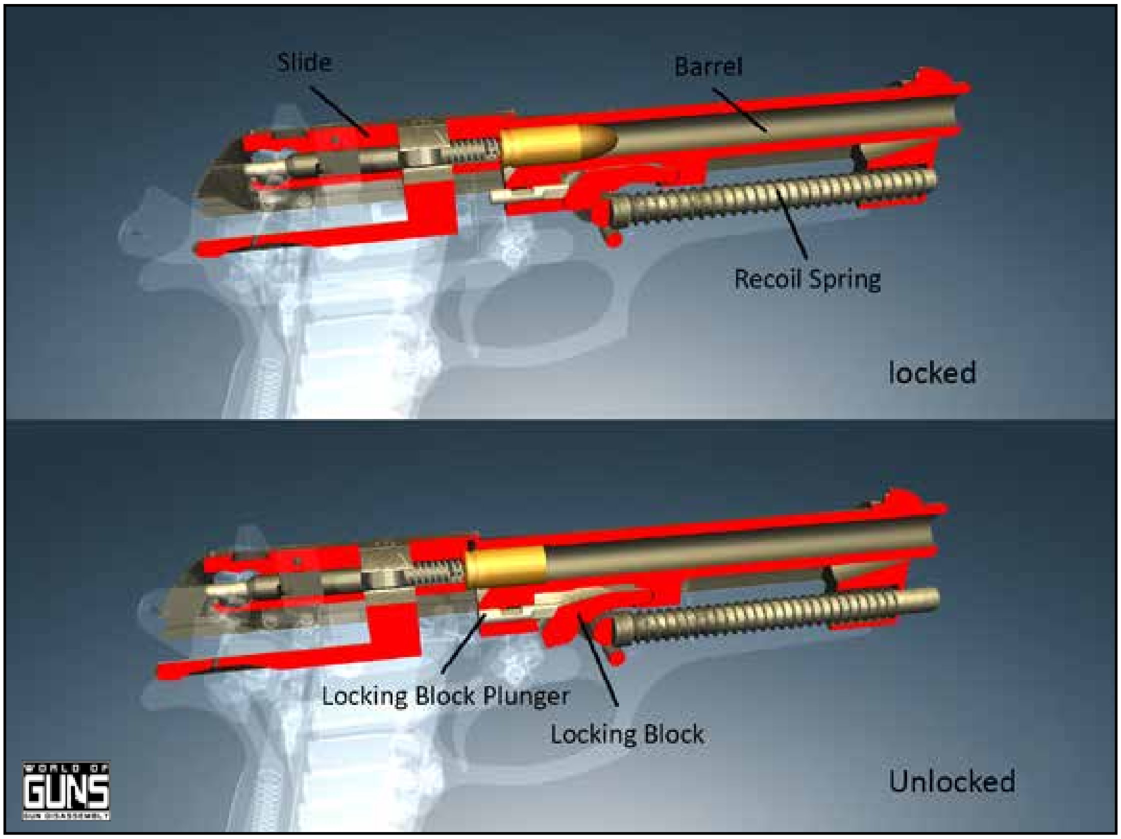

Figure 13: Inline locking action unlocking.

during the unlocking step. If the locking lugs on either the barrel or the bolt/slide or locking block are damaged, they may not be able to slide across each other smoothly and can cause the action to fail to unlock. If the action/recoil spring is damaged or broken, it may not allow the action to move far enough to unlock. If the action or chamber is excessively dirty or the chamber is rough, it may create enough friction to slow the action and cause a failure to unlock.

Repairing failure to unlock malfunctions with recoil-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the bolt/slide, barrel/extension, locking block, link, bushing or action/recoil spring. If the action and chamber are excessively dirty, you will need to thoroughly clean and lightly lubricate the action and chamber. If the chamber is rough, you will need to polish, thoroughly clean, and lightly oil the chamber.

Recoil Operation Extracting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract. Like other steps in a recoil-operated action's COO, the extracting step can be affected by ammunition and improper operator technique. Once ammunition or operator error have been ruled out, you can focus on the firearm.

With short recoil- and inertia-operated actions, when the cartridge is discharged, the barrel and bolt/slide unlock and the bolt/slide will begin to move backward. As the bolt/slide begins moving backward, the extractor's claw will grab the rim of the empty case. The bolt/slide will continue rearward, dragging the empty case from the chamber.

With long recoil actions, after the cartridge is discharged, the bolt and barrel will travel backward until the bolt bottoms out against the rear of the chamber. As the barrel travels forward

Figure 14: Inertia-operated action unlocking.

under spring force, extractors fixed to the bolt will hold the empty case to the bolt face. The empty case is extracted from the chamber by the barrel's forward movement.

If any part or assembly that controls extracting becomes broken, damaged, or worn, the firearm may experience failure to extract. The most likely cause of extraction malfunctions would be a broken, damaged, or worn extractor or extractor spring. If the extractor or spring is damaged or worn, it may not grab the rim of the case or may slip over the rim prematurely. If the action/recoil spring is broken or damaged, it may not allow the action to travel back far enough for the extractor to remove the case from the chamber. If the chamber is dirty or rough or the action is excessively dirty, it may create so much friction that the action does not complete its rearward stroke and fails to extract the case from the chamber. With long recoil actions, if the barrel return spring is broken, damaged, or worn, it may cause a failure to extract.

Repairing extraction malfunctions with recoil-operated actions is as simple as replacing the broken, damaged, or worn parts. This includes the extractor, extractor spring, action/recoil spring or barrel return spring. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate it. If the chamber is roughly machined, you will need to polish the chamber and thoroughly clean and lightly lubricate it. Once you have replaced parts, you will need to perform a function and safety check, followed by a test fire.

Recoil Operation Ejecting Problems

The last type of malfunction that may occur would be a failure to eject. Like other steps of a recoil-operated action's COO, the ejection step can be affected by ammunition and improper operator technique. Once ammunition and operator error have been ruled out as the cause of ejection malfunctions, you can focus on the remainder of the firearm.

With short recoil- and inertia-operated actions, after discharge, as the action moves rearward, the extractor will pull the empty case into the ejector. As the empty case contacts the ejector, it will begin to rotate around the extractor and out of the ejection port. Most recoil-operated actions utilize an ejector that is affixed to the frame.

With long recoil actions, after discharge, the action will bottom out against the rear of the receiver. The barrel will travel forward under return spring force while the empty case remains with the bolt. An ejector fixed to the barrel extension will contact the case head as the barrel travels forward. The ejector will cause the case to rotate around the extractor and out of the ejection port.

Figure 15: Short recoil action extracting.

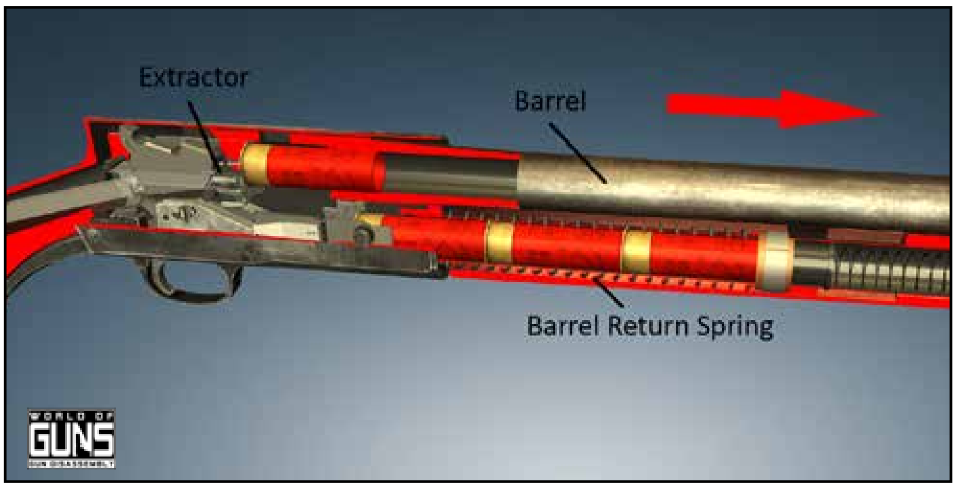

Figure 16: Long recoil action extracting.

If any part or assembly that controls ejecting becomes broken, damaged, or worn, the firearm may experience failure to eject. The most likely cause of a failure to eject would be the ejector itself. If the ejector is broken, damaged, or worn, when the empty case impacts the ejector, it may fail to exit the breech or become jammed in the action. The firearm may also experience erratic ejection and possibly eject cases directly at the operator. If the action/recoil spring or assembly is damaged, it may not allow the action to travel far enough backward to complete ejection. With long recoil-operated actions, if the barrel return spring is broken, damaged, or worn, it may fail to drive the barrel forward with enough force to properly eject the empty case. If the chamber is rough or excessively dirty, it may create so much friction that the action cannot eject the case completely.

Repairing ejection malfunctions with recoil-operated firearms is as simple as replacing the broken, damaged or worn parts. This includes the ejector, action/recoil spring or barrel return spring (if applicable). If the chamber is rough, you will need to polish and thoroughly clean it. If the action or chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate it.

Figure 17: Short recoil action ejecting.

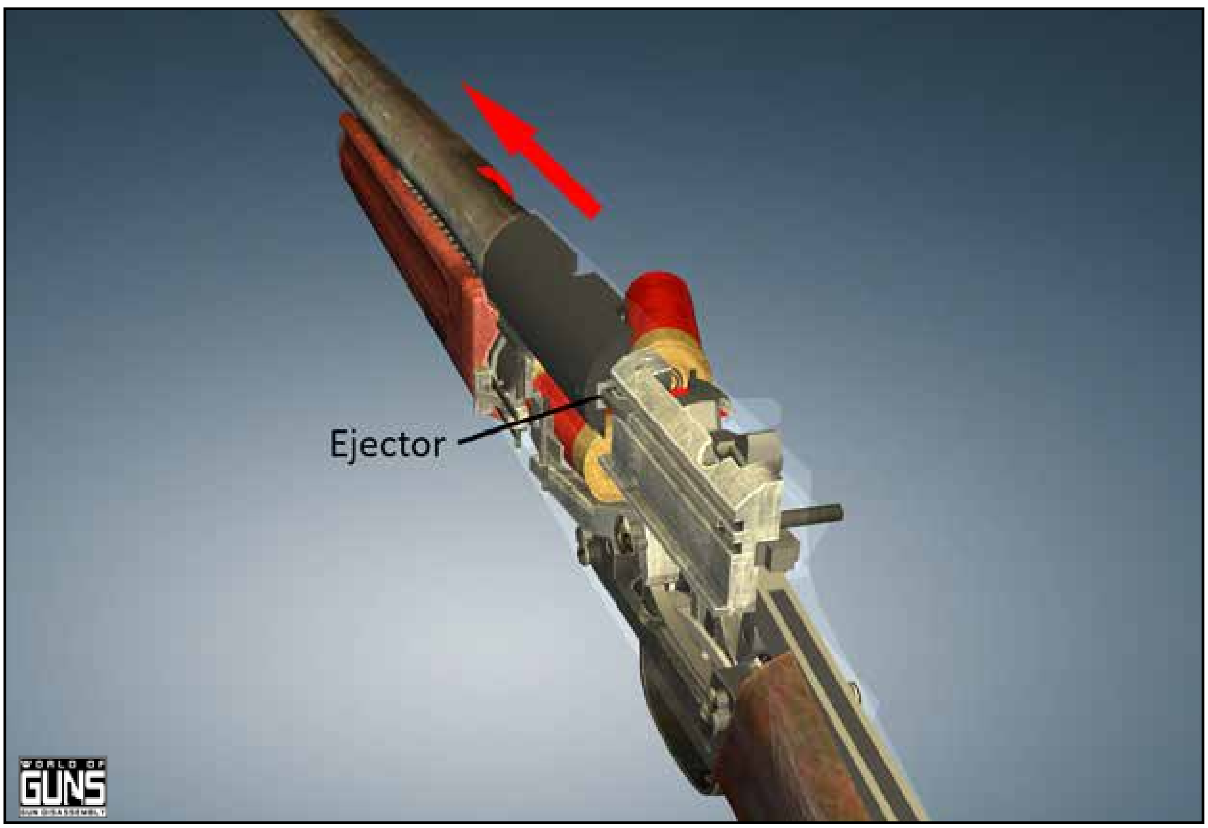

Figure 18: Long recoil action ejecting.

RECOIL-OPERATED ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Feed	1. Broken, damaged, or worn feed parts, including the magazine assembly, elevator/lifter, bolt/slide or action/recoil spring. 2. A roughly machined or undersized chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Lock	1. Broken, damaged, or worn parts, including the bolt/slide, barrel/extension, locking block, link, bushing or action/recoil spring. 2. Excessive dirt and debris in the action or chamber. 3. A roughly machined or undersized chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Thoroughly clean and lightly lubricate the action. 3. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Cock	1. Broken, damaged, or worn, FCG parts, including the hammer/striker, sear, disconnector, trigger or springs. 2. Broken, damaged, or worn action/recoil spring assembly. 3. Excessive dirt and debris in the action or chamber. 4. Roughly machined chamber.	1. Replace worn or damaged parts. Some sear surfaces can be dressed and polished. 2. Replace broken, damaged, or worn parts. 3. Thoroughly clean and lightly lubricate the action. 4. Polish, then clean and lightly oil the chamber.
Failure to Fire	1. Broken, damaged, or worn FCG parts, including the hammer/firing pin, striker and springs. 2. Long chamber/headspace. 3. Excessive dirt and debris in the FCG.	1. Replace broken, damaged, or worn parts. 2. Replace the barrel or bolt/slide. 3. Thoroughly clean and lightly lubricate the action.
Failure to Unlock	1. Broken, damaged, or worn parts, including the barrel, bolt/slide, locking block, link, pin or action/recoil spring. 2. Excessive dirt and debris in the action or chamber. 3. Roughly machined chamber.	1. Replace broken, damaged, or worn parts. 2. Thoroughly clean and lightly lubricate the action. 3. Polish, then thoroughly clean and lightly lubricate the chamber.

RECOIL-OPERATED ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Extract	1. Broken, damaged, or worn parts, including the extractor, extractor spring, action/recoil spring or barrel return spring. 2. Excessively rough or dirty chamber.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber.
Failure to Eject	1. Broken, damaged, or worn parts, including the ejector, action/recoil spring or barrel return spring. 2. Rough or excessively dirty chamber.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber.

Troubleshooting Gas-Operated Actions

Unlike the blowback or recoil-operated actions, which utilize direct or recoil energy to cycle the action, the gas-operated action uses high pressure gas tapped from the bore to cycle the action. Depending on the specific action design, the high pressure gas may act directly on the action (direct impingement) or against a piston that will (directly or indirectly) drive the action. Gas-operated actions are still susceptible to ammunition-induced malfunctions, but are less likely to experience malfunctions caused by operator error.

SHORT- AND LONG-STROKE PISTON AND DIRECT IMPINGEMENT OPERATED ACTIONS

There are three basic gas-operated actions: short- and long-stroke piston and direct impingement operated. These action types are similar in two ways: they feature fixed barrels, and when the projectile passes by the gas hole in the barrel, the gas is forced through the barrel wall and into the gas port(s). You will need to have a thorough understanding of the function of the gas-operated systems and the nuances of each action design. Although all gas-operated firearms function in the same basic manner, each individual design will vary slightly in the way by which it operates.

Gas-Operation Feeding Problems

Beginning with the feeding step in the COO, the first type of malfunction(s) a gas-operated firearm can experience would be failures to feed. Because of the function of the action, gas-operated firearms are always magazine-fed. Depending on the specific model, the firearm may be fed by a fixed (tubular) magazine or by a fixed or detachable box magazine. Each specific feed type will feature a different feeding sequence and will have different parts to diagnose.

Regardless of feed type, the initial step in the feeding process of gas-operated firearms is the same. With a fully loaded magazine, an empty chamber, and a closed breech, the operator manipulates the bolt/charging handle (or slide). As the operator drives the bolt/charging handle to the rear of the action, it will begin to compress the action/recoil spring.

With tubular magazine-fed recoil-operated actions, as the action continues rearward, the bolt will trip the elevator/lifter, which will begin to move downward in preparation for feeding. As the bolt continues rearward, either the bolt or elevator/lifter will trip a cartridge release/stop that will allow one round from the magazine to enter the breech and onto the elevator lifter. Once the operator has reached the end of the bolt's stroke, the action/recoil spring will be fully compressed and ready to drive it forward.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle, allowing the action to move forward under spring force. The action/recoil spring will drive the bolt forward. As the bolt moves forward, it

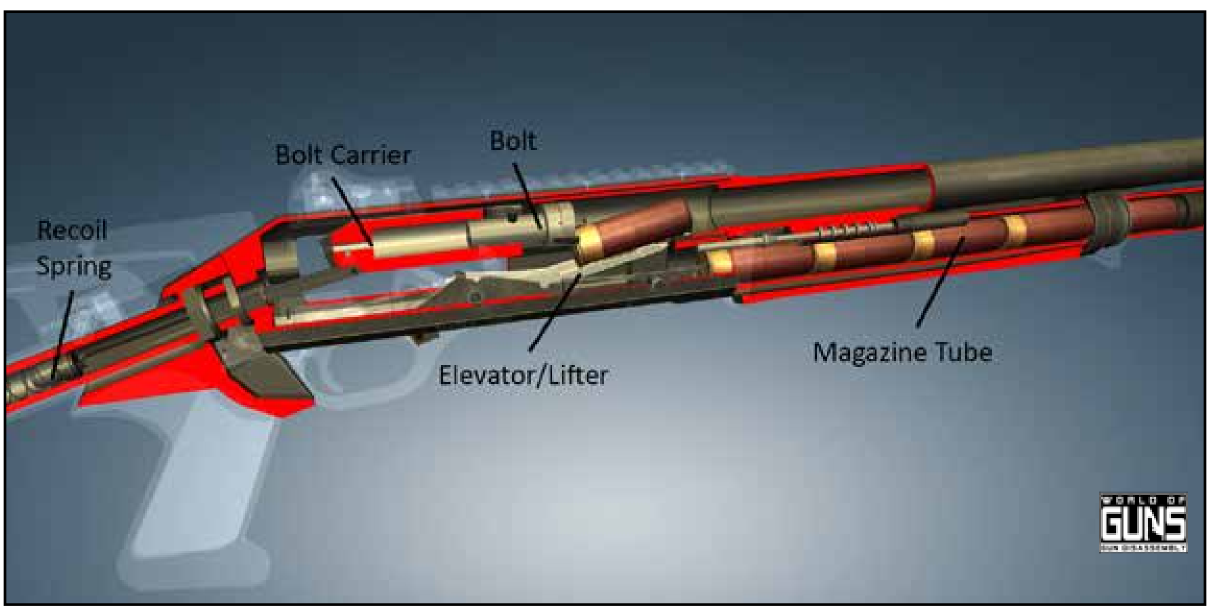

Figure 1: The feeding step of a tubular magazine-fed gas-operated action.

Figure 2: The feeding step of a box magazine-fed gas-operated action.

will trip the elevator/lifter and force it upward, bringing the cartridge into alignment with the bolt. As the bolt continues forward, it will begin to push the cartridge from the elevator/lifter and drive it into the chamber. The bolt will continue forward until it has contacted the barrel, driving it forward and locking the round in the chamber.

With box magazine-fed (fixed and detachable) gas-operated actions, as the action continues rearward, the bolt (or slide) will pass over the top cartridge in the magazine (pushing it downward slightly) and continue rearward until it has reached the end of its rearward stroke. Once the bolt has reached the end of its rearward travel, the action/recoil spring will be fully compressed and ready to drive the action forward again.

With the action/recoil spring fully compressed, the operator releases the bolt/charging handle, allowing the action to move forward under spring force. As the bolt moves forward, a lug (typically the cocking lug) on the bottom of the bolt will contact the head of the cartridge case and begin to drive it from the magazine. The bolt will continue forward, driving the round from the magazine until it has entered the chamber. The bolt will continue driving the cartridge forward until it has locked against the barrel extension or receiver.

Regardless of the feed device type, once the bolt has locked up with the barrel, the round has been fully fed into the chamber. If any one of the parts that controls the feeding step becomes broken, damaged, or worn, it may lead to a failure to feed. This includes the magazine (tubular or box) assembly, elevator/lifter (tubular magazine firearms only), the bolt/slide, or the action/recoil spring assembly. If the magazine assembly is broken, damaged or worn, it may allow too many cartridges into the breech at once, or may fail to even feed a single round. If the elevator/lifter is broken, damaged, or worn, it may fail to raise the round into the path of the bolt. If the lug on the bolt/slide is broken, damaged, or worn, it may fail to drive the round from the magazine or may cause misalignment of the round as it moves toward the chamber. If the action/recoil spring

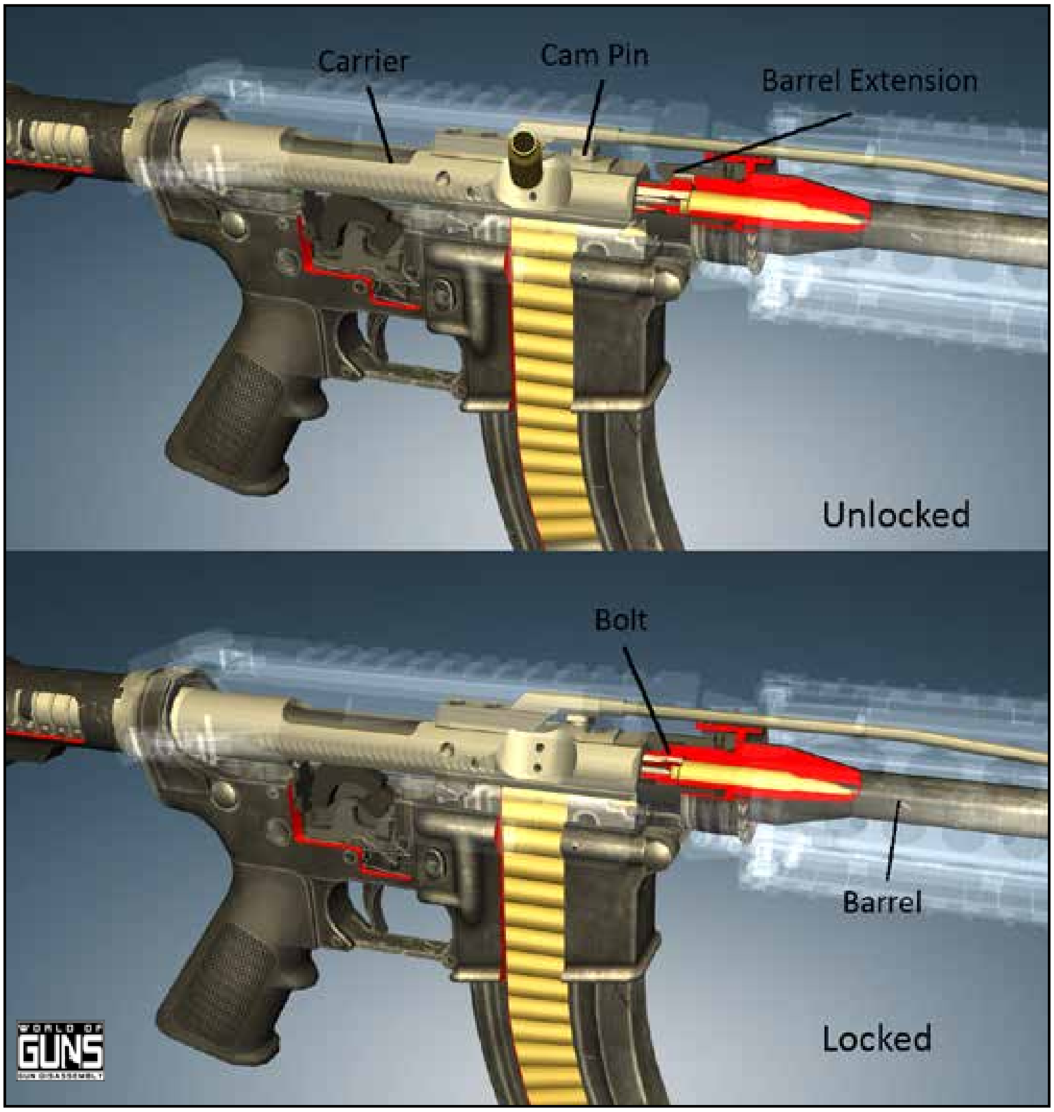

Figure 3: Rotating bolt gas-operated action locking.

assembly is broken, damaged, or worn, it may fail to drive the bolt/slide with enough force to fully chamber the cartridge. Two less likely (but still possible) causes of a failure to feed would be a roughly machined or undersized chamber or excessive dirt and debris.

Repairing failure to feed malfunctions with gas-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the magazine assembly (body, spring and follower), elevator/lifter (tubular magazine firearms only), bolt/slide, action/recoil spring and chamber. If you must replace the bolt/slide, you will need to perform a headspace check. If the issue is caused by a short or rough chamber, you will need to polish or recut the chamber to SAAMI specs. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate the chamber. Once you have replaced parts, you will need to perform a function and safety check, followed by a test fire.

Gas-Operation Locking Problems

The next type of malfunction you may experience with gas-operated firearms would be a failure to lock. Every gas-operated firearm utilizes a true locking breech design, but the locking step will vary with each specific action. We will

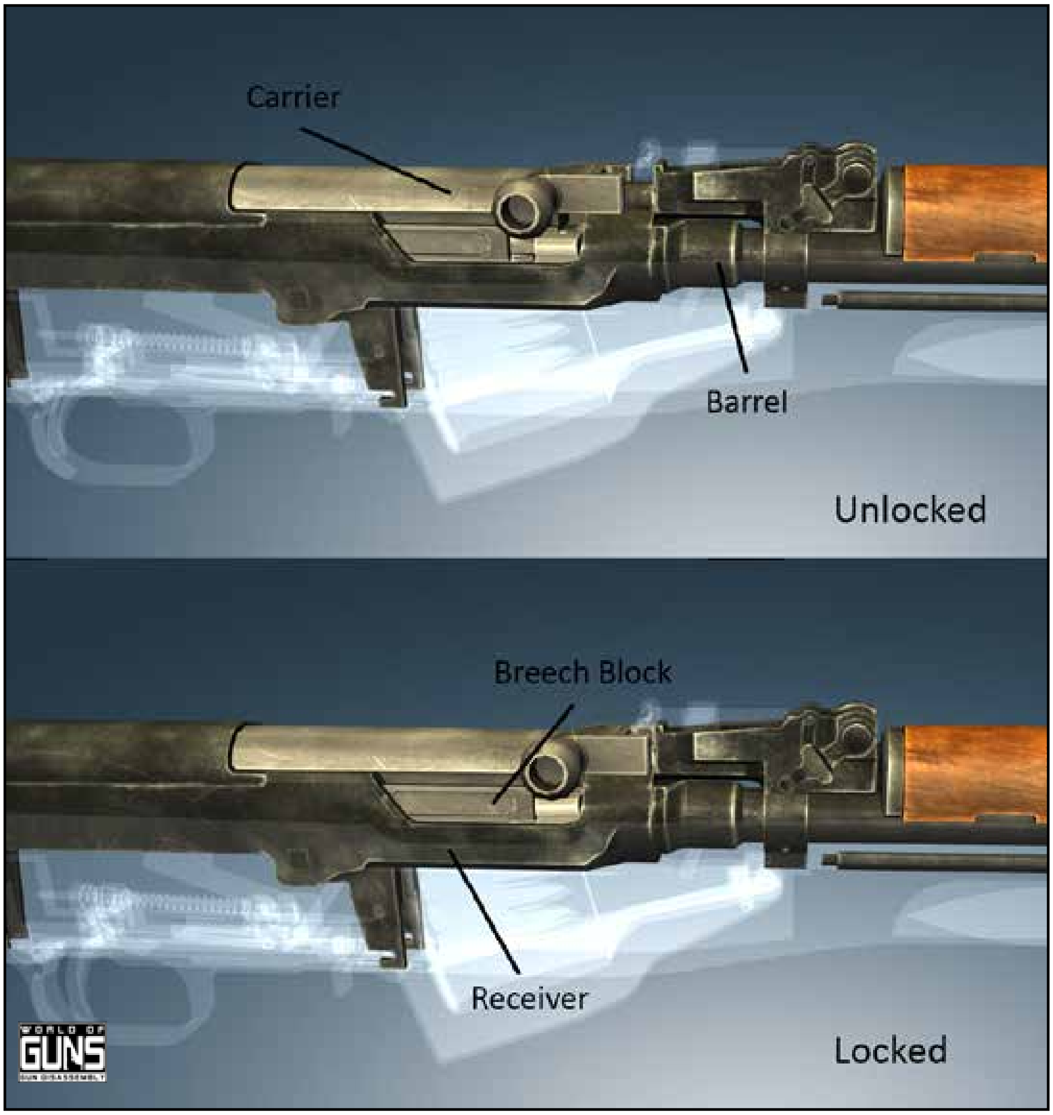

Figure 4: Falling/tilting breechblock gas-operated action locking.

discuss the locking step of the two major gas-operated actions types: rotating bolt and falling/tilting breechblock. As the action is cycling, or after the operator has released the bolt/charging handle and the bolt has stripped the round from the magazine/elevator, the bolt will drive the round into the chamber. This is where the similarities between the action types end.

With rotating bolt actions, as the bolt drives the round into the chamber, it will bottom out against the fully seated round. The bolt carrier will continue forward (under action/recoil spring force), forcing a camming pin located in the bolt to follow a cutout slot in the carrier. The slot will force the bolt to rotate (in place), which will cause the bolt lugs to align with the locking lugs on the barrel extension. Once the bolt carrier has bottomed out against the breech face of the barrel and the bolt lugs are in alignment with the lugs on the barrel extension, the breech is fully locked.

With falling/tilting breechblock actions, as the breechblock drives the round into the chamber, right before the breechblock bottoms out against the round in the chamber, it will drop into a recess in the receiver. The lugs on the breechblock will align with locking lugs on the receiver, locking the cartridge in the chamber but not the

breech. The breechblock carrier will continue forward until it bottoms out against the breech face of the barrel, covering the breechblock and locking the breech.

If any part or assembly that controls locking is broken, damaged, or worn, the firearm may fail to completely lock. This includes the bolt/breechblock, carrier, receiver, cam pin or barrel extension. If the locking lugs on the barrel extension/receiver or bolt/breechblock are worn, it may allow the breech to unlock prematurely. If the bolt/breechblock, carrier, cam pin, receiver or barrel extension is broken or damaged, it may not allow the breech to fully lock.

The action/recoil spring may also cause locking malfunctions. If the spring is broken, damaged or worn, it may not drive the action hard enough to lock the breech completely. Gas-operated actions are also susceptible to locking malfunctions caused by excessive dirt and debris. Excessive friction will slow the action enough to prevent the breech from fully locking. A short or rough chamber can also lead to locking malfunctions.

Repairing failure to lock malfunctions with gas-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the bolt/slide, barrel/extension, locking block, link, bushing or action/recoil spring. If the action and chamber are excessively dirty, you will need to thoroughly clean and lightly lubricate the action and chamber. If the chamber is rough or undersized, you will need to polish or recut the chamber.

Gas-Operation Cocking Problems

Continuing through the COO, the next type of malfunction you may encounter would be a failure to cock. The cocking step of a gas-operated firearm occurs automatically when the action cycles after a cartridge has been discharged. The cocking step also occurs when the operator charges the firearm, loading the first cartridge into the empty chamber. With gas-operated actions, the cocking step may occur with either a hammer or striker. The addition of a part known as the disconnector will also introduce another factor when diagnosing issues.

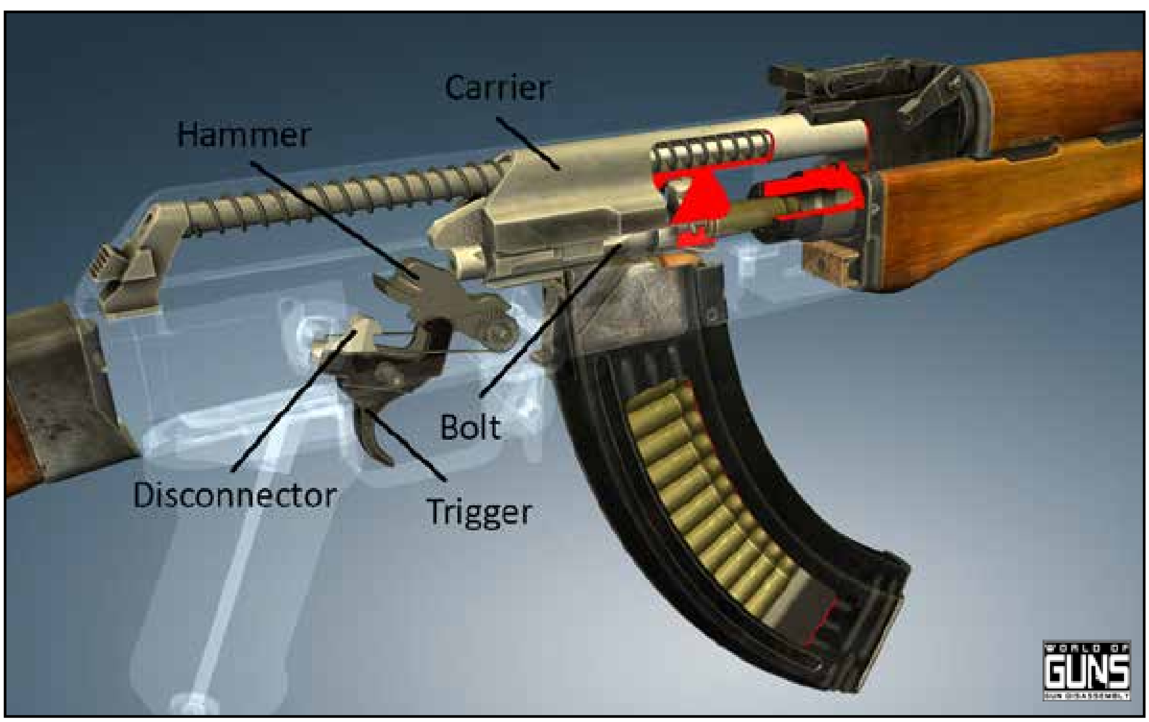

Figure 5: Gas-operated action cocking.

With hammer-fired models, when the operator loads the firearm in preparation for firing, as he/she pulls the charging handle to the rear of the action, an integral cocking lug on the underside of the bolt will contact the striking face of the hammer and begin to drive it back and downward into the cocked position. Simultaneously, if the operator is still holding the trigger, the bolt will trip the disconnector, allowing it to trap the hammer. If the operator has released the trigger, the hammer will be trapped by the sear or trigger, fully cocked and ready to fire. The bolt will continue rearward until it reaches the end of its rearward stroke and slams forward under action/recoil spring force.

With striker-fired models, when the operator loads the firearm, as the action moves backward, the bolt will carry the striker with it. Simultaneously, if the operator is still holding the trigger, the bolt will trip the disconnector, allowing the sear to move into position to trap the striker. If the operator has released the trigger, the sear will already be in position, ready to trap the striker. The bolt will continue rearward until it reaches the end of its rearward stroke and slams forward under action/recoil spring force. As the bolt travels forward, the striker will be trapped by the sear, fully cocked and ready to fire.

When the operator fires the round, the energy created during discharge will drive the bolt rearward once more, cocking the hammer/striker. Each time a round is fired, the action will cycle and cock the hammer/striker. This cycle will continue until the magazine is empty.

If any part or assembly that controls cocking becomes broken, damaged, or worn, it may lead to a failure to cock. Because of the design of the gas-operated action, ammunition and the operator can both contribute to cocking malfunctions in the form of short-stroking. Short-stroking occurs with gas-operated actions when the cartridge fails to produce enough energy to drive the action completely through its stroke. It will also occur when the operator fails to hold the firearm with enough force to prevent it from recoiling excessively, causing the energy used to cycle the action to dissipate.

Once you have ruled out ammunition and operator error as possible causes for malfunction, you can focus on the remainder of the action. The most likely cause for a failure to cock malfunction would be damage or wear to the FCG parts, including the hammer/striker, hammer strut, trigger, sear, disconnector, and respective springs. If the sear surfaces are worn or damaged, the hammer/striker may only cock temporarily before prematurely falling. If the hammer strut or hammer or striker spring is damaged or broken, the hammer/striker may fail to cock at all.

A less likely but still possible cause of a failure to cock would be the action/recoil spring. If the action/recoil spring is broken or damaged, it may not allow the action to travel far enough to the rear of its travel to fully cock the hammer/striker. Excessive dirt and debris inside the action can also lead to a failure to cock if the fouling produces enough friction to slow the cycling action. A dirty or roughly machined chamber can also create enough friction to slow the action and cause a failure to cock.

Repairing failure to cock malfunctions is as simple as replacing broken, damaged, or worn FCG parts. This includes the hammer/striker, strut, hammer spring, sear, sear spring, disconnector, disconnector spring, trigger and trigger springs. You may want to replace both sear surfaces (the sear and hammer/striker) to ensure there are no further complications from new parts working against old parts. In some instances, the sear surfaces can be dressed (outlined earlier in this guide) to try to save hard-to-find parts. Once the parts have been replaced or repaired, thoroughly clean the FCG and lightly lubricate all contact points. Perform a function and safety check before you perform a final test fire to ensure everything functions correctly.

Gas-Operation Firing Problems

Moving through the COO, the next type of malfunction that may occur would be a failure to fire. Like other action types, failure to fire

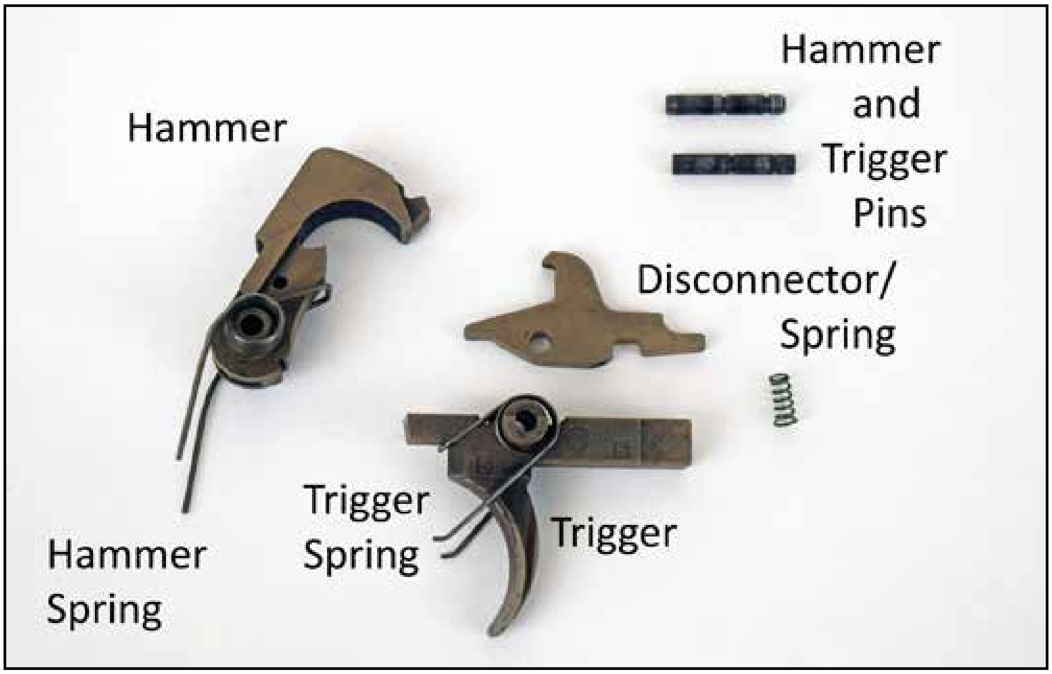

Figure 6: Gas-operated action FCG.

malfunctions with gas-operated actions can be contributed to one assembly: the FCG. The firing step will vary slightly depending on if the system is hammer- or striker-fired.

If the firearm utilizes a hammer assembly, when the operator presses the trigger and releases the hammer, it will fall and contact the firing pin. The firing pin will lunge forward, striking the primer and discharging the round. If the firearm utilizes a striker assembly, when the operator presses the trigger, the sear will release the striker, allowing it to lunge forward and strike the primer.

If any part of the FCG becomes broken, damaged, or worn, the firearm may experience a failure to fire. The most likely causes for failures to fire with gas-operated actions would be a broken or damaged firing pin/striker or a worn hammer or striker spring. If the firing pin or striker is damaged or broken, it may fail to create an indentation on the primer or may make an indentation that is too shallow. If the hammer or striker spring is worn or broken, it may not drive the hammer/striker quickly enough to strike the primer hard enough.

A few less likely but still possible causes would be a long chamber or long headspace or excessive dirt and debris inside the FCG. Because of the allowable tolerances of the chamber, firing pin/striker and cartridge, if the chamber is on the long side and the ammunition is on the short side, the firing pin/striker may not be able to create a deep enough depression in the primer. If the FCG is excessively dirty, it may create enough friction to slow the hammer and firing pin or striker enough to create a light strike.

Repairing failure to fire malfunctions with gas-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the hammer/striker, hammer spring, striker spring, firing pin or other parts of the FCG that may interfere with the firing step. If the FCG is excessively dirty, you will need to thoroughly clean and lightly lubricate the parts. If the issue is caused by a long chamber, you may need to replace the barrel or the bolt slide. If you do replace the barrel or bolt, you will need to perform a headspace check. Once you have replaced the parts, you will need to perform a function and safety check, followed by a test fire.

Gas-Operation Unlocking Problems

The next type of malfunction that you may experience would be a failure to unlock. The unlocking step will vary with each specific action design, but will begin the exact same way. When the operator presses the trigger and discharges the cartridge, the pressure created during discharge will force the bullet from the bore. Some of this high pressure gas will be diverted through a small hole in the barrel called the gas port. A part known as the gas block, which rests on the barrel and encompasses the gas port, will direct the gas from the gas port toward the action. This is where the similarities between the gas-operated actions end.

With short-stroke piston actions, the tapped gas from the gas port is directed into a gas tube, which houses the piston. The high pressure gas will begin to push the piston backward. Once the piston begins to move, one of two things will happen, depending on the specific design: either the piston will act directly against the bolt/carrier or against an operating rod that will act against the bolt/breechblock carrier. The piston (and operating rod) will only move a short distance before stopping, while the carrier continues rearward.

If the system utilizes a breechblock, an angled lug on the carrier will hook a similar lug on

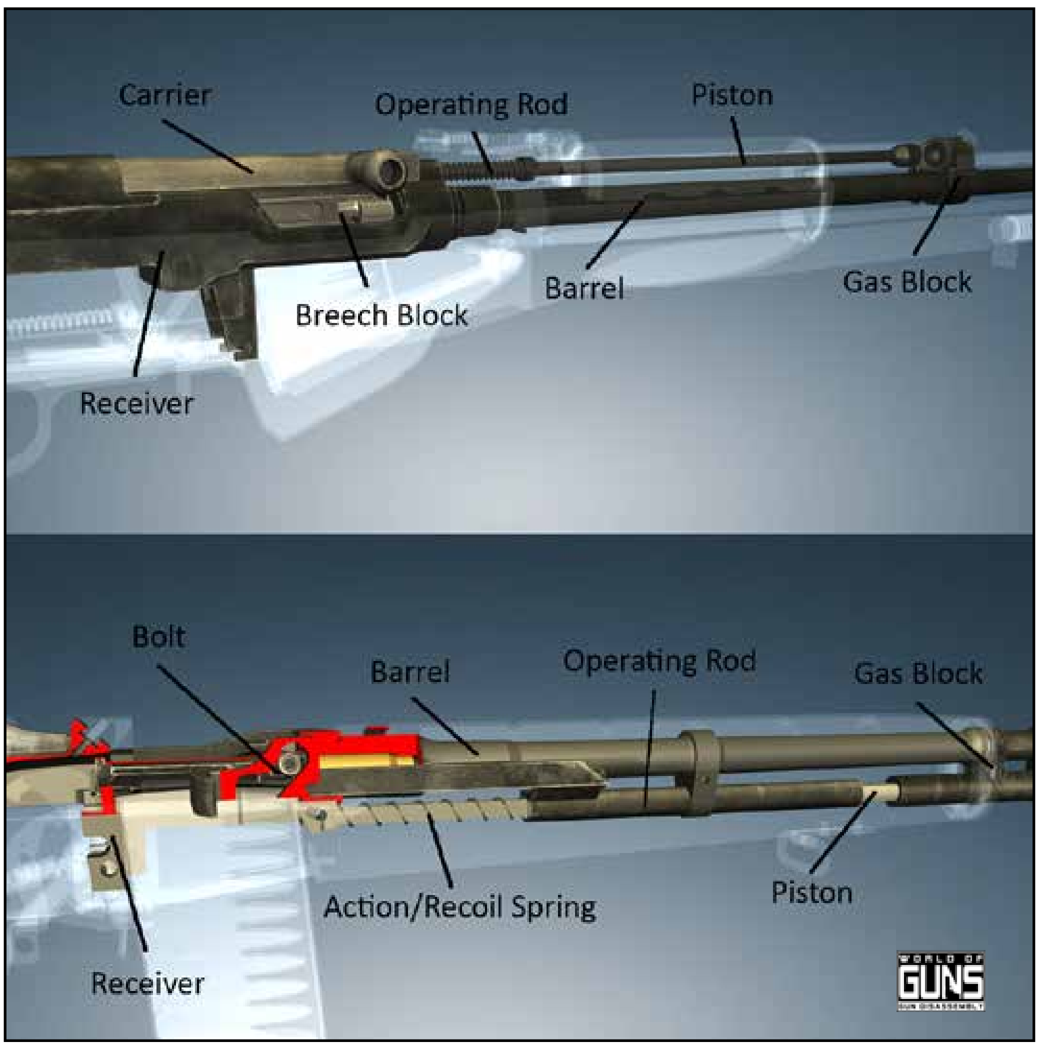

Figure 7: Falling/tilting breechblock and rotating bolt short-stroke piston action unlocking.

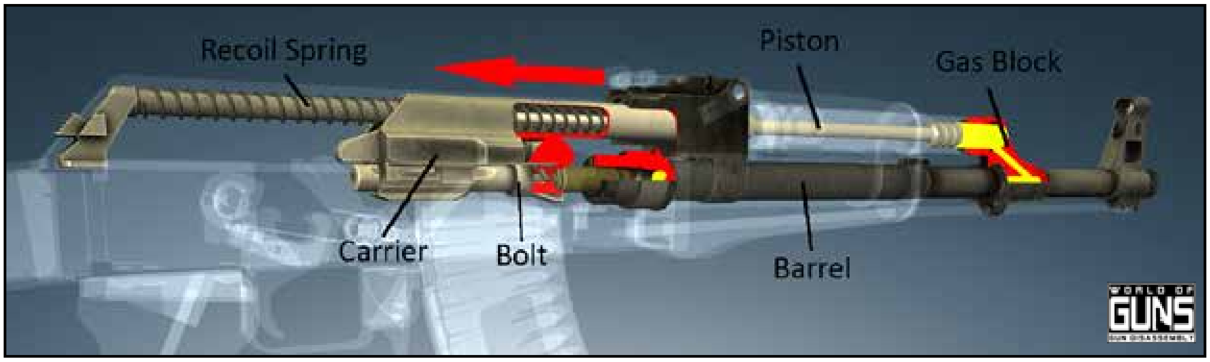

Figure 8: Rotating bolt long-stroke piston action unlocking.

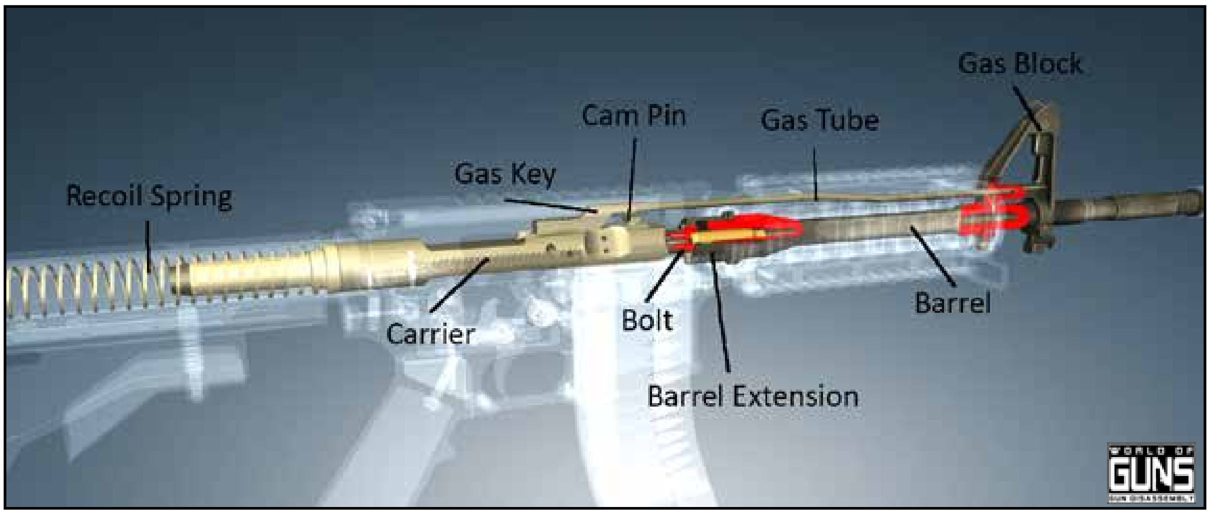

Figure 9: Rotating bolt gas impingement action unlocking.

the breechblock and force the breechblock to rise from the slot in the receiver. As the carrier continues rearward, it will completely lift the breechblock from the slot in the receiver and continue rearward to cycle the action. If the system utilizes a rotating bolt, the slot in the carrier will begin to force the camming pin to start rotating the bolt. As the carrier continues rearward, the cam pin will force the bolt's lugs to clear the lugs on the barrel extension and allow the bolt and carrier to travel rearward and continue through the action's cycle.

With long-stroke piston actions, the tapped gas from the gas port is directed into a gas tube, which houses the piston. The high pressure gas will begin to push the piston (which is attached directly to the carrier) backward. As the carrier (and piston) moves backward, the slot in the carrier will force the camming pin (or lug) to turn the bolt. Once the bolt's lugs have cleared the lugs on the barrel extension (or trunnion), the bolt, carrier, and piston will continue backward through their stroke.

With direct impingement actions, the tapped gas from the gas port is directed into a gas tube, which will direct it from the gas block directly to the bolt carrier. The gas tube directs the high pressure gas into a part called the gas key, which transfers the gas into a chamber between the bolt and carrier. This high pressure gas will force the carrier backward, which will force the bolt to begin to rotate. Once the bolt's lugs have cleared

the lugs of the barrel extension, the carrier will carry the bolt rearward through its stroke.

If any part or assembly that controls unlocking becomes broken, damaged, or worn, the firearm may fail to unlock. This includes the bolt/breechblock, barrel, receiver, gas block, gas tube, piston/operating rod, or recoil spring. If the lugs on the bolt/breechblock or barrel extension/receiver/trunnion become broken or worn, it may allow the breech to unlock prematurely. If the lugs are damaged, they may not allow the breech to unlock at all. If the gas block, gas tube, piston or operating rod is broken or damaged, it may fail to drive the carrier backward with enough force to unlock the action. If the gas port on the barrel is clogged with excessive copper and carbon fouling, it may not allow enough gas pressure to pass through to completely unlock the action. If the recoil spring is broken or damaged, it may not allow the carrier to move back far enough to unlock the breech. If the action and chamber is excessively dirty or if the chamber is rough, it may create enough friction to slow it and prevent unlocking.

Repairing failure to unlock malfunctions with gas-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the bolt/breechblock, barrel/extension, carrier, gas block, gas tube, piston, operating rod or action/recoil spring. If the gas port is filled with excessive fouling, you will need to thoroughly clean the port and possibly re-drill the hole. If the action and chamber are excessively dirty, you will need to thoroughly clean and lightly lubricate the action and chamber. If the chamber is rough, you will need to polish, thoroughly clean, and lightly oil the chamber. If you must replace the bolt or slide, you will need to perform a headspace check.

Gas-Operation Extracting Problems

Continuing through the COO, the next type of malfunction that may occur would be a failure to extract. The extraction step of a gas-operated action is susceptible to an ammunition-induced malfunction as well as some (extreme) operator-induced ones, in the form of short-stroking. Once ammunition and operator error have been ruled out, you can focus on the remainder of the action.

When the cartridge is discharged, high pressure gas begins to push against the piston or carrier, forcing the bolt/breechblock to unlock. The

Figure 10: Gas-operated action extracting.

Figure 11: Fixed and dynamic gas-operated firearm ejectors.

extractor's claw will grab the rim of the empty case as the bolt begins to move backward. As the bolt continues through its rearward stroke, the extractor will drag the empty case from the chamber.

If any part or assembly that controls extracting becomes broken, damaged, or worn, the firearm may experience failure to extract. The most likely cause for extraction malfunctions would be a broken, damaged, or worn extractor or extractor spring. If the extractor or spring is damaged or worn, it may not grab the rim of the case or may slip over the rim prematurely. If the action/recoil spring is broken or damaged, it may not allow the action to travel back far enough for the extractor to remove the case from the chamber. If the chamber is dirty or rough or the action is excessively dirty, it may create so much friction that the action does not complete its rearward stroke and fails to extract the case from the chamber. If any part of the gas system is broken or damaged, it may not be able to drive the action back far enough for extraction.

Repairing extraction malfunctions with gas-operated actions is as simple as replacing the broken, damaged, or worn parts. This includes the extractor, extractor spring, gas system or action/recoil spring. If the chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate it. If the chamber is roughly machined, you will need to polish the chamber and thoroughly clean and lightly lubricate it. Once you have replaced parts, you will need to perform a function and safety check, followed by a test fire.

Gas-Operation Ejecting Problems

The last type of malfunction that may occur would be a failure to eject. Ejection malfunctions can vary with gas-operated firearms because they employ two different ejector types: fixed and dynamic. Fixed ejectors are attached to the receiver of the firearm. As the action cycles and the bolt/breechblock moves to the rear, the extractor will pull the case into the ejector and cause it to deflect away from the ejector and out of the ejection port. Much of the reliability of this type of ejection is dependent on the shape and location of the ejector and the force of the action cycling.

Dynamic ejectors are spring-driven and live in the bolt face. The ejector places constant force against the head cartridge case as the extractor holds the case to the bolt face and the action is cycling to the rear. Once the case has been fully extracted from the chamber, the ejector

will immediately try to throw the case from the ejection port. The reliability of dynamic ejectors is less dependent on inside forces (the energy of the action cycling) and in turn, provides more consistent ejection.

If any part or assembly that controls ejecting becomes broken, damaged, or worn, the firearm may experience failures to eject. The most likely cause for a failure to eject would be the ejector itself. With fixed ejectors, if the ejector is broken, damaged, or worn, when the empty case impacts the ejector, it may fail to exit the breech or become jammed in the action. With dynamic ejectors, if the ejector or spring is damaged or broken, it may fail to drive the empty case from the breech. The firearm may also experience erratic ejection and possibly eject cases directly at the operator. If the recoil spring or assembly is damaged, it may not allow the action to travel far enough backward to complete ejection. If the chamber is rough or excessively dirty, it may create so much friction that the action cannot eject the case completely.

Repairing ejection malfunctions with gas-operated firearms is as simple as replacing the broken, damaged, or worn parts. This includes the ejector, spring, or recoil spring. If the chamber is rough, you will need to polish and thoroughly clean it. If the action or chamber is excessively dirty, you will need to thoroughly clean and lightly lubricate it.

GAS-OPERATED ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Feed	1. Broken, damaged, or worn feed parts, including the magazine assembly, elevator/lifter, bolt/slide or recoil spring. 2. A roughly machined or undersized chamber.	1. Replace broken, damaged or worn parts or assemblies. 2. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Lock	1. Broken, damaged, or worn parts, including the bolt, barrel extension, breechblock, receiver, carrier, cam pin or recoil spring. 2. Excessive dirt and debris in the action or chamber. 3. A roughly machined or undersized chamber.	1. Replace broken, damaged, or worn parts or assemblies. 2. Thoroughly clean and lightly lubricate the action. 3. Polish, then clean and oil the chamber. Recut the chamber to SAAMI specs.
Failure to Cock	1. Broken, damaged, or worn FCG parts, including the hammer/striker, sear, disconnector, trigger or springs. 2. Broken, damaged, or worn recoil spring assembly. 3. Excessive dirt and debris in the action or chamber. 4. Roughly machined chamber.	1. Replace worn or damaged parts. Some sear surfaces can be dressed and polished. 2. Replace broken, damaged, or worn parts. 3. Thoroughly clean and lightly lubricate the action. 4. Polish, then clean and lightly oil the chamber.
Failure to Fire	1. Broken, damaged, or worn FCG parts, including the hammer/firing pin, striker and springs. 2. Long chamber/headspace. 3. Excessive dirt and debris in the FCG.	1. Replace broken, damaged, or worn parts. 2. Replace the barrel or bolt/slide. 3. Thoroughly clean and lightly lubricate the action.
Failure to Unlock	1. Broken, damaged, or worn unlocking parts, including the bolt/breechblock, barrel, receiver, gas block, gas tube, piston/operating rod, or recoil spring. 2. Excessive fouling and carbon inside the gas port. 3. Excessive dirt and debris in the action and chamber. 4. Rough chamber.	1. Replace broken, damaged, or worn parts. 2. Clean out the gas port/re-drill. 3. Thoroughly clean and lightly lubricate the action. 4. Polish, then clean and lightly oil the chamber.

GAS-OPERATED ACTION TROUBLESHOOTING		
Malfunction	**Possible Causes**	**Solution**
Failure to Extract	1. Broken, damaged, or worn parts, including the extractor, extractor spring, recoil spring or gas system. 2. Excessively rough or dirty chamber.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber.
Failure to Eject	1. Broken, damaged, or worn parts, including the ejector, spring or recoil spring. 2. Rough or excessively dirty chamber.	1. Replace broken, damaged, or worn parts. 2. Polish and thoroughly clean and lightly lubricate the chamber.

NOTES

Glossary of Firearm Malfunctions

NOTES

Accidental Discharge – When a cartridge is discharged from a firearm unintentionally. An accidental discharge may be caused by broken fire control parts or from dirt or debris jamming these parts. Excessive dirt or debris in the firing pin channel of certain firearms may cause a slam fire. Parts breakage may be accidental, but most modern day firearms have additional, redundant safeties to prevent accidental firing. A slam fire may be prevented and can be blamed on negligence of the operator, because of improper or poor firearm maintenance. An accidental discharge may also be INCORRECTLY referred to a *negligent discharge*.

Correction: An accidental discharge can always be prevented by practicing safe firearm handling. Treating every firearm as if it were loaded, never pointing at anything you don't intend to destroy, and always keeping your finger off the trigger are some measures used to prevent an accidental or negligent discharge. Even in the event of parts breakage, by never pointing the firearm at anything you don't intent to destroy you can assure little or no injury to you or anyone around you.

Bent Case Rim – A sign of either a firearm or ammunition malfunction. A bent case rim is a sign of hard extraction either from a rough or dirty chamber, timing issues or an overcharged cartridge. A rough or dirty chamber will create extra friction against the case while the extractor tries to remove it from the chamber. Timing issues will cause the breech to unlock prematurely, forcing the extractor to pull against a case that is still expanded against the chamber walls. An overpressure cartridge will cause the case to expand beyond its normal capacity and stick to the chamber walls.

Correction: Because a bent case rim may be caused by either the firearm or ammunition, the cause must be identified. Use different brands of ammunition to see if the problem persists. If the firearm is determined to be the cause, you can start by thoroughly cleaning the chamber and bore to help alleviate pressure spikes. If the issue continues, even after cleaning, then the chamber may be roughly machined. Smooth and polish the chamber, taking care not to change the chamber's dimensions.

With semi-automatic firearms, timing issues are harder to diagnose. Fixing timing issues varies with different action types, but may include stiffer or lighter action/recoil springs, manipulation of the flow of gas, or increasing or decreasing friction of contact points or weight of reciprocating parts.

Blowback – A condition that occurs where hot, high pressure gas and burning propellant spew from the breech of a firearm during discharge. Blowback can be caused by excessive headspace, chamber pressure, very "hot" ammunition (loaded to or beyond SAAMI max pressure), or a combination of multiple factors. Extra pressure or a larger-than-spec chamber can cause cases to expand beyond their capacity and rupture, blowing gas and debris out of the breech toward the operator. Also, very dirty chambers, throats, and bores can create dangerously high pressure spikes that may lead to blowback.

Correction: The first indicator of blowback that is the easiest to diagnose is excessive chamber pressure. The fired cases will provide most of the evidence. The most obvious signs are blown, flattened, or pierced primers. Taking measurements of the fired cases and comparing them to SAAMI specifications can also reveal excessive case stretch, headspace, or incorrect chamber dimensions. Firearms that feature an ejector that protrudes from the bolt face may see signs of the case head flowing into the ejector hole. If an unfired bullet will pass through the neck of a fired case, it is a good indication that the neck of the chamber is not undersized or was cut too tight.

Thoroughly cleaning the chamber and bore of the firearm is the easiest and most common fix. Using a quality copper and lead remover may help to alleviate some of the pressure.

Headspace can be measured with Go/No-Go gauges to verify the chamber is within spec. If the chamber is out of spec, the whole barrel will need to be replaced. If there is not enough headspace, the chamber may need to be slightly reamed. If there is excessive headspace, depending on model, the barrel, bolt, or both may need to be replaced (Figure 0.1).

Blown Primer – An ammunition or firearm malfunction where the primer is forced out of the primer pocket. A blown primer can be caused by excessive headspace, chamber pressure, excessive cartridge reloading, and may even be a timing issue. Timing may cause the bolt to unlock too soon, forcing the extractor to pull a pressurized case from the chamber. Regardless of the cause, the real issue is overpressure in the case/chamber/bore area and must be addressed immediately.

Correction: If only a few cartridges in a particular batch of ammunition have blown primers, it may be because they were overcharged. If multiple cartridges over several brands of ammunition are blowing primers, then the firearm is likely the cause. Also, if a case has been reloaded multiple times, the primer pocket may begin to open from wear. This may cause primers to fit loosely in the pocket, making them more susceptible to blowing.

If the firearm is the cause, then the first measure would be to clean the chamber and bore thoroughly with a quality copper and lead remover. Also, using Go/No-Go gauges will let you verify that the chamber and headspace are within spec. If it is determined that headspace is the cause, the barrel, bolt, or both may need to be replaced depending on model.

With semi-automatic firearms, timing issues are harder to diagnose. Stretching or deformation around the case head where the extractor pulled the case from the chamber or bulges around where the ejector sits against the case are signs of a timing issue. Fixing timing issues varies with different action types, but may include stiffer or lighter action/recoil springs, manipulation of the flow of gas, or increasing or decreasing friction of contact points or weight of reciprocating parts (Figure 0.2).

Figure 0.1/0.2*- A few cases with undeniable signs of over-pressure. These cases were pressurized to the point of failure, causing dangerous amounts of blowback. Blown primers, and case head extrusion/separation can lead to more serious issues when the escaping hot gasses begin to erode the breech face and other action parts.*

Bolt Override – A firearm or magazine malfunction found in M16/AR-15-style rifles, where a cartridge or fired case becomes jammed in the receiver. The case or cartridge becomes wedged above the bolt between the charging handle and gas key. A bolt override may be caused by a failure to eject, or by bent or broken feed lips on the magazine.

Correction: The first step in clearing a bolt override malfunction is as follows:

1. Move the selector lever to the "safe" position.
2. Depress the magazine release and drop the magazine.
3. Clear any loose rounds in the receiver.
4. With the charging handle in the closed, locked position and the muzzle pointed at the ground, use the head of a cartridge or lip of the magazine to push up against the bolt carrier.
5. Shake the rifle, and use gravity to clear the obstruction.

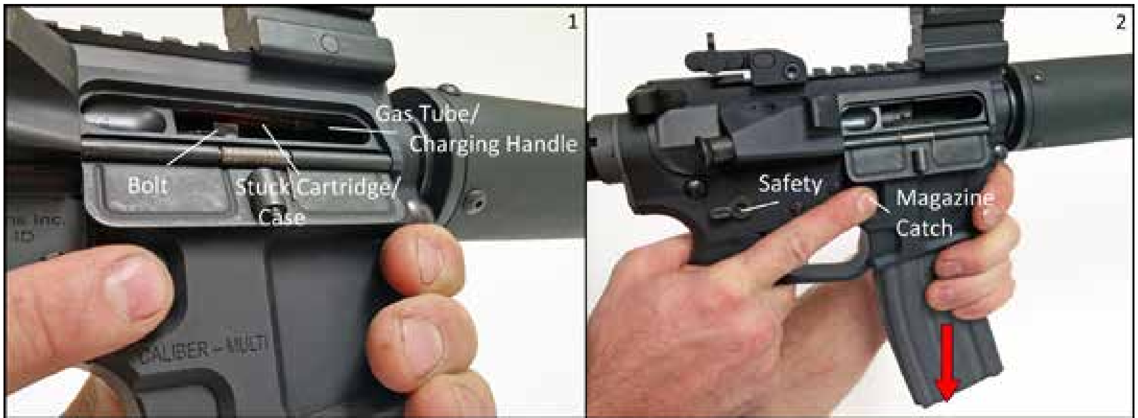

Figure 0.3*- A bolt override can be a difficult malfunction to try to clear quickly. The first step in clearing any malfunction is properly identifying the type of malfunction (1). Remember that with a bolt override malfunction the cartridge/case is jammed between the charging handle and bolt carrier, so trying to manipulate the charging handle will only make things worse. Work slowly and keep your fingers clear of the breech because the bolt carrier is under spring tension and will slam shut when the case is removed. Initiate the safety and remove the magazine (2). Use the head of a case to push the carrier to the rear and shake the rifle to help remove the case (3).*

6. Cycle the action to make sure all obstructions have been cleared.

The rifle is now ready to load and fire.

If the problem persists, there may be something mechanically wrong with the firearm or magazine. If only one magazine causes the malfunction, the magazine is the issue. If the malfunction occurs with multiple magazines, then the ejector in the bolt may be the cause. If the ejector is found to be the cause, then it should be replaced (the ejector spring also if possible) (Figure 0.3).

Bolt-Over-Base – A firearm, magazine, or operator malfunction where the bolt or slide rides over a round in the magazine, failing to chamber it, and causing a jam. The most common bolt-over-base cause comes from a magazine that is not fully seated and locked into place. Another cause comes from a weak or broken magazine spring failing to lift the cartridges fast enough for feeding. A bolt-over-base malfunction may also be caused by a worn or out-of-spec bolt or slide, magazine catch, or by a condition known as short-stroking. A bolt-over-base malfunction is a type of failure to feed.

Correction: To clear a bolt-over-base malfunction you must first do the following:

1. Initiate the safety device, if possible.
2. Depress the magazine release and drop the magazine.
3. Lock the bolt or slide open, if possible.
4. Turn, shake, and use gravity to clear the obstruction from the breech.
5. Cycle the action multiple times to make sure all obstructions have been cleared.

The firearm is now ready to load and fire.

The first step in avoiding a bolt-over-base malfunction is to ensure the magazine is locked securely in the firearm. If one magazine causes the same malfunction multiple times, the magazine may be bad. If multiple magazines cause the same malfunction, then the firearm may be the issue. A good way to pinpoint the problem is to cycle snap caps through the action and watch where the jam occurs. Replace or repair parts (magazine, springs, follower, magazine catch, bolt or slide) as needed (Figure 0.4).

Case Head Separation – A cartridge failure commonly found with reloaded cases, where the brass becomes thin or fatigued near the case head. When fired, the head blows off or is ripped off by the extractor. Head separation can also be attributed to work hardening. A case head separation can be very dangerous as it may let hot, high pressure expanding gas out through the breech.

Correction: Because head separation is found mostly with reloaded cases, using new factory-loaded ammunition will ensure reliable operation. Thoroughly examine each case when reloading for discolored rings or hairline cracks near the case head. Use a paperclip to feel for thin spots on the inside of the case near the head. If head separation occurs and the ammunition is not the cause, then there may be an issue with the firearm. Excessive headspace and pressure or timing issues can cause head separation. Also, a roughly machined chamber may lead to head separation.

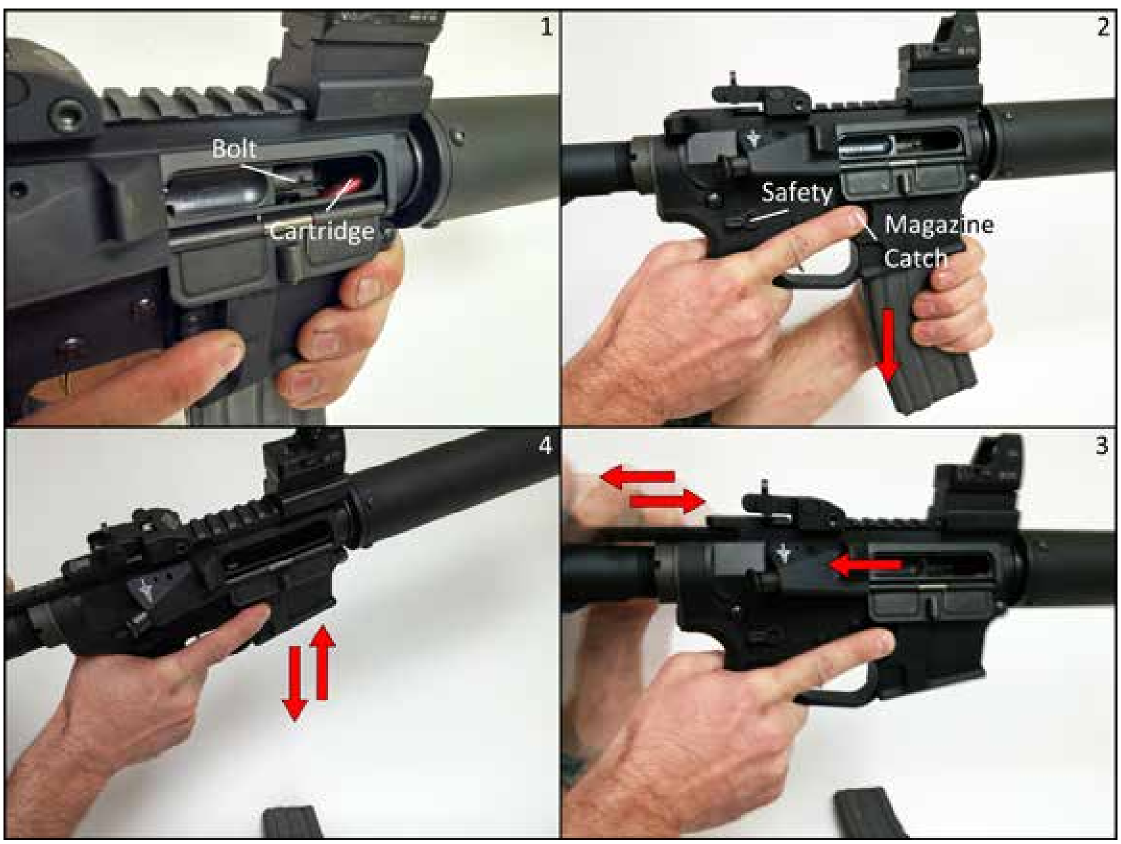

Figure 0.4– *A bolt-over-base malfunction (1) is typically caused by the operator failing to seat the magazine properly. To clear a bolt-over-base, initiate the safety and remove the magazine (2). Manipulate the charging handle (3) and shake the firearm to free the stuck cartridge. This same procedure can be used for any type of repeating, magazine-fed firearm. The only difference is in the names of the action parts (bolt/charging/operating handle or slide).*

Thoroughly cleaning the chamber and bore of the firearm is the easiest and most common fix. Using a quality copper and lead remover may help to alleviate some of the pressure.

Headspace can be measured with Go/No-Go gauges to verify the chamber is within spec. If the chamber is out of spec, the whole barrel will need to be replaced. If there is not enough headspace, the chamber may need to be slightly reamed. If there is excessive headspace, depending on model, the barrel, bolt, or both may need to be replaced.

With semi-automatic firearms, timing issues are harder to diagnose. Stretching or deformation around the case head where the extractor pulled the case from the chamber or bulges around where the ejector sits against the case are signs of a timing issue. Fixing timing issues varies with different action types, but may include stiffer or lighter action/recoil springs, manipulation of the flow of gas, or increasing or decreasing friction of contact points or weight of reciprocating parts.

A rough chamber can be lightly polished to alleviate some friction when the extractor pulls against the case head. Care must be taken not to alter the dimensions of the chamber because it may lead to more serious issues (Figure 0.5).

Figure 0.5- Reloading a case multiple times or loading it beyond SAAMI recommended maximum load can cause case head separation. Multiple loadings can cause work hardening in the brass that lead to stress fractures and eventually complete separation. Loading a cartridge beyond recommended safe load can cause excessive chamber pressure that can either blow the case head off or cause it to be ripped off by the extractor.

Cook Off – A condition where a cartridge is discharged through thermal ignition. Cook off is caused by an overheated chamber igniting the primer or propellant. Cook off is mostly encountered with automatic firearms and extensive rapid firing.

Correction: If cook off occurs when using a semi-automatic firearm that employs a closed bolt design, cease fire immediately. Remove the magazine and any remaining cartridges from the firearm and lock the breech open. Allow the action and chamber to cool before continuing. Cook off can be prevented by avoiding excessive and prolonged rapid firing.

Double Feed – A firearm or magazine malfunction where there is a cartridge being fed into a chamber that already contains a cartridge or case. Double feeds can be caused by a fail to extract or by bent or broken magazine feed lips allowing more than one round to be released at a time.

Correction: To clear a double feed you must first do the following:

1. Initiate the safety, if possible.
2. Depress the magazine release and remove the magazine.
3. Cycle the action and use gravity to help clear the cases and cartridges. Once all cartridges and cases are clear, the firearm is ready to load and fire.

After experiencing a double feed, try using a different magazine to see if the problem continues. If the magazine is the issue, the feed lips may be bent or damaged. If the issue persists, the extractor, extractor spring, ejector or ejector spring may be worn, bent or broken and need to be replaced.. A roughly machined or dirty chamber may cause cases to become stuck,

leading to a double feed. Cleaning and polishing the chamber may help alleviate any extraction issues (Figure 0.6).

Dud – A cartridge whose primer or propellant fails to ignite. A dud must be handled with care because there is still a slight chance the round will still ignite, like in the case of a hang fire.

Correction: To clear a dud, the first thing you must do is wait at least a minimum of 30 seconds. After 30 seconds, initiate the safety, if possible. Remove the dud from the chamber and dispose of it properly (most ranges will have a bucket for duds) (Figure 0.7).

Extruded Case Head/Primer – An ammunition malfunction where pressure causes case/primer material to flow into the ejector/firing pin channel. Extrusion is typically caused by an overcharged cartridge but may also be caused by excessive fouling in the chamber/bore of the firearm causing pressure spikes.

Figure 0.7- *Even though there was sufficient energy striking the primer, the round still failed to ignite. Improper storage is the most likely cause. The powder, primer or both may have been exposed to moisture that would cause it to deteriorate.*

Correction: Because extrusion can be caused by either the firearm or ammunition, the cause must be determined. Use different brands and lots of ammunition to see if the issue persists. If the firearm is determined to be the cause, then you should thoroughly clean the chamber and bore of fouling (copper, lead, carbon

Figure 0.6- *A double feed malfunction (1) is most often caused by bent or broken feed lips. To clear a double feed, initiate the safety and remove the magazine (2). Manipulate the slide to clear any loose rounds from the breech. This same procedure can be used to clear a double feed in any type of repeating, magazine-fed firearm. The only difference is in the names of the action parts (bolt/charging/operating handle or slide).*

and propellant) buildup. If the problem persists, check the dimensions of the chamber to assure it is within spec. A "tight" chamber will cause an increase in pressure that could lead to extrusion. Replace or repair the barrel if necessary.

Fail to Eject – A firearm malfunction in which the ejector fails to expel the spent case from the breech before the action closes, causing the spent case to become stuck. A failure to eject can be caused by a bent or damaged ejector or from insufficient spring pressure. A failure to eject on semi-automatic pistols may also be caused by a condition known as *limp wristing*.

Correction: If you experience a failure to eject while shooting, you must first do the following:

1. Initiate the safety, if possible.
2. Remove the magazine (semi-automatic) or open/remove the cylinder (revolver).
3. Use gravity to assist you when removing the spent case. Repeatedly manipulate the slide or bolt (semi-automatic or other repeaters) or depress the ejector (revolver).

If you are unable to eject the case, or if the problem continues, you may have to replace, repair or tune the ejector or ejector spring. With some types of semi-automatic actions the erratic ejection may be caused by ammunition or timing issues. Any inconsistencies from round to round will cause erratic ejection and could cause a malfunction.

With pump-, bolt-, and lever-actions the ejection issues may be operator-induced. Failing to fully cycle the firearm's action the total distance of its travel, or failing to cycle the action hard or smooth enough, can lead to ejection issues. To correct a failure to eject that is caused by limp wristing, you simply have to lock your wrists while you are shooting.

Fail to Extract – A firearm malfunction where the extractor is unable to remove the spent case from the chamber. A fail to extract may be caused by damage or wear to the extractor, a weak extractor spring, or by a dirty or rough chamber. A fail to extract may also be caused by ammunition, wherein steel cases may become stuck in the chamber because they do not contract as much as brass. Reloaded ammunition may cause a fail to extract in the case of a head separation. A failure to extract may lead to a double feed with semi-automatic firearms. Also, if a round has been loaded and unloaded multiple times without firing, the case head may become worn or chipped, allowing the extractor to slip over and leaving the cartridge behind.

Correction: While shooting, if you experience a failure to extract you must first do the following:

1. Initiate the safety, if possible.
2. Remove the magazine (semi-automatic).
3. Rack the slide, manipulate the bolt, or push the ejector rod (revolvers) several times to try to catch the case rim. If the cartridge does not extract and eject, you will need to remove the round from the muzzle end. This can be very dangerous when removing a live cartridge.

To remove a fired case, you must first open the action and secure the bolt/slide/breechblock to the rear. Tap the case out from the muzzle end with a wood or soft metal (brass or aluminum) rod that is slightly smaller than the bore in diameter.

To remove a live cartridge, you must remember to ALWAYS keep the firearm pointed in a safe direction. If possible, try to fire the round into an appropriate backstop. If you are unable to discharge the round, you need to open the action and secure the bolt/slide/breech to the rear. Tap the case out from the muzzle end with a wood or soft metal (brass or aluminum) rod that is slightly smaller than the bore in diameter. If

you are unable to remove the cartridge, you can try to freeze the action and barrel. The thin-walled brass case will contract more than the thick-walled steel chamber. Try to tap it out with a rod once again. If the case remains stuck, you may need to disassemble the firearm and remove the barrel.

In the case of a head separation, there is no case head to pull or tap against. You can use a brass bore brush that is larger in diameter than the inside diameter of the case to try to create enough friction to remove the case. You can also use a specialized tool known as a broken shell extractor.

If you continue to experience extraction issues, you need to determine if the firearm or ammunition is the cause. Use various brands and types of ammunition. If you experience extraction issues with multiple types of ammunition, you may need to repair, replace or tune the extractor.

If the issue persists, you should check the chamber for rough machining that may be causing excessive friction on the cases. If the chamber is rough, you must polish out the machine marks, taking care not to alter the dimensions of the chamber (Figure 0.8).

Fail to Feed – A firearm's malfunction that occurs when a cartridge fails to align properly while entering the chamber, creating a malfunction in the form of a jam. A failure to feed can be caused by the firearm, or by the magazine, or ammunition. Most modern semi-automatic firearms feature some type of feed ramp either on the receiver or integral with the barrel to help guide cartridges into the chamber. Sometimes these ramps are designed only for a specific bullet profile, like a round nose full metal jacket, and will have difficulty feeding bullets with an open tip profile like a hollow-point. If magazine feed lips are bent or out of spec, they can fail to align the next cartridge properly.

Correction: With semi-automatic firearms, most feeding issues are caused by the magazine itself. Try using different magazines to see if the

Figure 0.8- A failure to extract (1) can lead to other malfunctions, such as a double feed. To clear a double feed you need to initiate the safety and remove the magazine (2). Manipulate the slide until all loose rounds have cleared the firearm (3). This same procedure can be used to clear a failure to extract in any type of repeating, magazine-fed firearm. The only difference is in the names of the action parts (bolt/charging/operating handle or slide).

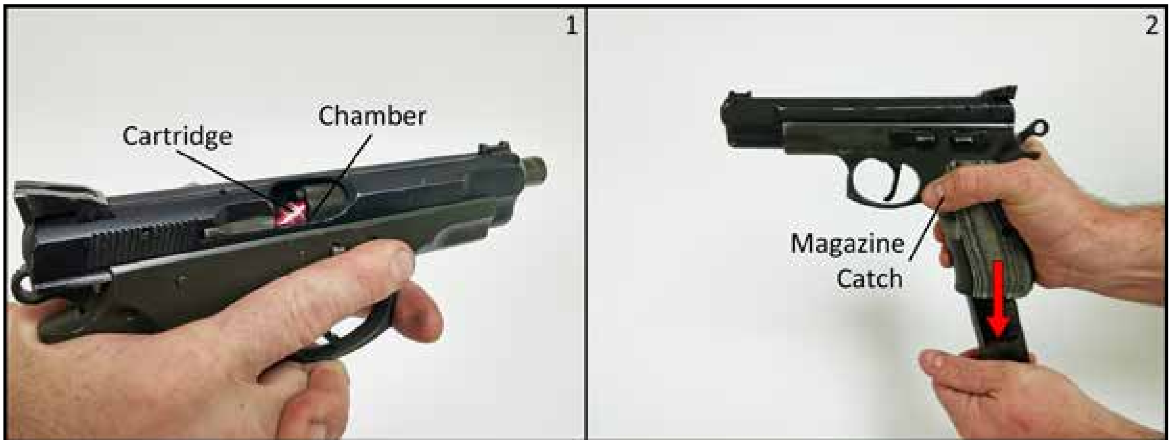

Figure 0.9- A failure to feed (1) can have several causes. To clear a failure to feed you must initiate the safety and remove the magazine (2). Manipulate the slide until all loose rounds are free from the firearm. This same procedure can be used to clear a failure to feed in any type of repeating, magazine-fed firearm. The only difference is in the names of the action parts (bolt/charging/operating handle or slide).

issue is with the magazines or firearm itself. The same applies to different types of ammunition with different tip profiles (round, hollow, flat, or stepped/truncated).

If you are experiencing issues with multiple magazines and types of ammunition, then you may need to address the feed ramp and throat area of the barrel. You may need to lightly polish or reprofile the feed ramp and throat to aid in the cartridge's alignment and feeding into the chamber (Figure 0.9).

Fail to Fire – A firearm or ammunition malfunction where the cartridge fails to ignite. The failure may be due to an insufficient amount of energy striking the primer, a defective primer, or because of propellant or cartridges that have been ruined from improper storage. See also Dud.

Correction: If failures to fire are experienced with different brands and lots of ammunition, than the issue is with the firearm. Any part of the fire control group could be responsible for the issues. Clean and lubricate the firearm, especially the fire control parts, to see if the problem continues.

With hammer-fired firearms, you will need to examine the hammer, hammer spring, firing pin, firing pin spring, decocker/safety(s) and transfer bar (if applicable). Check the hammer and firing pin for burrs and signs of dragging. Remove all burrs and smooth or polish scratches and polish the contact points of dragging parts. Check the firing pin tip for chips or breakage. Make sure springs are not sagging or worn. Replace springs as necessary.

For striker-fired firearms, you will need to examine the striker, striker spring, sleeve(s) and

safety(s). Check the striker and safety(s) for burrs or signs of dragging. Remove burrs and smooth and polish scratches and contact points. Check the striker tip for chips or breakage. Check springs for sagging and wear and replace if necessary.

Flattened Primer – An indication or sign of high or excessive pressure or headspace. Some calibers of ammunition will normally flatten a primer slightly. If a primer is flattened completely, it is a sign of overpressure and could lead to a dangerous situation. Also, because of variances in material of manufacture, some primers may flatten more than others.

Correction: Excessive pressure can be caused by either the firearm or ammunition. To determine which is the cause, try using different brands of ammunition to see if the problem persists. If the firearm is determined to be the cause, the first step to try to solve the issue is to thoroughly clean the firearm, especially the chamber and bore. Any buildup of fouling (lead, copper, carbon, propellant) can lead to flattened primers.

Excessive headspace can also cause primers to flatten when the case head slams against the bolt/breech face. Headspace can be measured with Go/No-Go gauges. If headspace is determined to be the issue, it may lead to more serious problems. Either the barrel, the bolt/slide/breechblock, or both will need to be replaced (Figure 1.0).

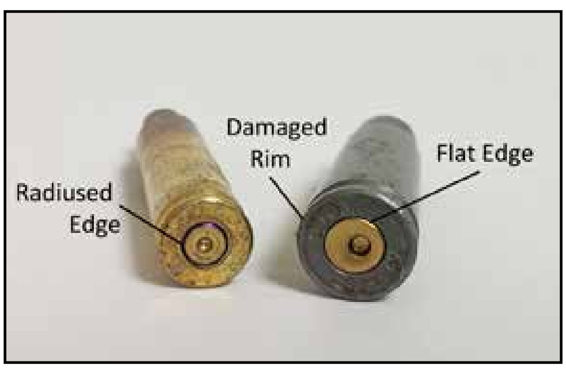

Figure 1.0– *There is a clear difference between the profile of the normal (left) primer and the flattened (right) one. Even the profile of the crater from the firing pin strike shows pressure signs. The damage to the case rim is also another indicator of pressure causing hard extraction.*

Hammer Follow – A firearm malfunction that occurs when the hammer or striker chases the bolt or slide as it closes and locks the breech. Hammer follow can result in a light strike or fail to fire, it can also lead to an accidental discharge (slam fire) in a worst case scenario. Hammer follow may be a result of a faulty disconnector or bad sear engagement.

Correction: A bent or broken disconnector/interrupter can release the hammer prematurely. Repair or replace the disconnector and replace the disconnector spring. If the problem persists, check hammer/sear engagement.

Any alteration of hammer/sear engagement from angle to shape may cause the hammer to slip and follow the bolt/slide. There are two safe and one dangerous hammer/sear engagement profiles. A positive or neutral sear engagement angle will create a safe but sometimes heavy (positive angle) trigger pull. A negative sear engagement angle will allow the hammer to push or slip off of the sear. If the hammer or sear cannot be repaired, then they must be replaced (Figure 1.1).

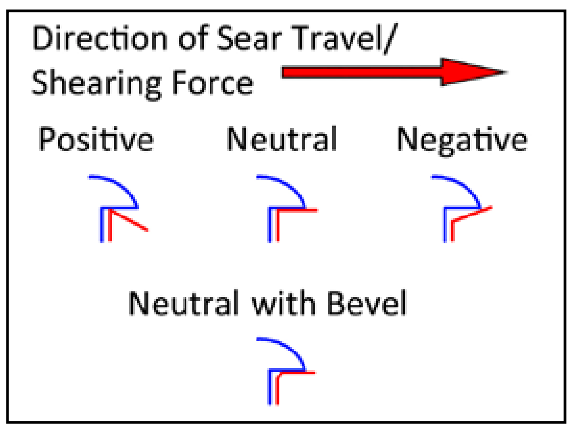

Figure 1.1– *The angle of the sear in relation to the hammer/striker's sear surface and its direction of travel will greatly affect how the fire control group performs. The angle can mean the difference between a safe (positive/neutral) or dangerous (negative) trigger or a heavy (positive) or short, light (neutral with bevel) trigger.*

Hang Fire – An ammunition malfunction where there is a delay in propellant ignition after the primer has been struck. The cartridge may fire a few seconds after the initial strike. This situation should be treated with caution.

Correction: A hang fire may be confused with a dud or fail to fire. If you experience what you think may be a dud/fail to fire, you should keep the firearm pointed in a safe direction for a minimum of 30 seconds. After 30 seconds you can be assured that ignition is very unlikely.

Light Strike – A firearm malfunction that occurs when the firing pin does not have enough energy to properly crush the anvil and primer to create ignition. A light strike may be a result of worn or damaged firing pin springs or hammer springs, or from a condition known as hammer follow.

Correction: Any part of the fire control group could be responsible for the issues. Clean and lubricate the firearm, especially the fire control parts, to see if the problem continues. Check the hammer/striker/firing pin springs to assure that it has not begun to sag and still produce sufficient pressure. Replace as needed. Also, check the fire control parts for wear or signs of dragging. Smooth or polish any contact points to allow for fluid motion (Figure 1.2).

***Figure 1.2**- The shallow indentation is a sign of a light strike. Somewhere in the fire control group there is a broken part or an excessive amount of friction. Repairing broken parts or replacing worn springs will solve this issue.*

Limp Wristing – While shooting recoil-operated firearms, it is a condition that will cause a malfunction known as a short stroke. Most commonly found with semi-automatic pistols when the receiver is allowed to move with the slide, absorbing energy needed to cycle the action. Limp wristing is caused when the firearm is not held securely enough or while shooting pistols when the wrists are not locked.

Correction: Limp wristing can be cured with a proper grip. Getting the shooting and support hands as high up against the bore axis of the

***Figure 1.3**- For a semi-automatic pistol to perform reliably, all of the available energy used to cycle the action must be transmitted to the slide. If the frame is allowed to move, it will absorb cycling energy and cause the slide to reduce its amount of travel. If the slide is unable to travel the full distance of its stroke, it could fail to extract the spent case, eject the spent case, cock the hammer/striker, feed a new round or lock the breech.*

firearm will prevent the muzzle from flipping excessively. Locking your wrists and gripping the firearm with enough force so that it does not slip in your hands will also cure any issues. Also, the use of isometric tension will aid in securing the firearm and controlling recoil (Figure 1.3).

Misfire – A failure of a cartridge to ignite after the primer is struck. A misfire can occur from wet or chemically deteriorated propellant or debris in the flash hole. A misfire is a type of failure to fire. See also Dud.

Neck Split – A type of ammunition malfunction where the neck area of the case fractures. The most likely cause of a neck split comes from work hardening. Work hardening occurs in cases that have been reloaded multiple times. A neck split may also be the result of dirt or debris in the chamber. During discharge, chamber pressure forces the case against the debris creating a pressure point, and cracking. Also known as a season crack.

Correction: A neck split is a case malfunction most commonly associated with reloading. If you do not reload and experience a case neck split, you should clean the chamber area of the barrel. If the problem persists, the chamber may be damaged or out of spec. If the chamber is out of spec or damaged, the barrel will need to be replaced (Figure 1.4).

Figure 1.4*- Continuously reloading cartridges without periodically annealing them can lead to work hardening of the neck and shoulder and eventually fractures and cracks. Annealing the neck/shoulder area of the case will return some of its ductility and make it safe to reload a few more times.*

Negligent Discharge – An unexpected discharge of a firearm due to carelessness. Usually caused by putting a finger inside of the trigger guard when a round is chambered. A negligent discharge is an operator induced malfunction.

Correction: A negligent discharge can be prevented by practicing safe firearm handling. Treat every firearm as it were loaded, always point it in a safe direction, and never point it at anything you are not willing to destroy. Also, keep your finger away from the trigger, outside of the trigger guard, along the frame until your sights are on target and you are ready to shoot.

Pierced Primer – A primer that has been punctured by a firing pin that is too long or that has a sharp face. Excessive wear on the firing pin can cause it to protrude further from the firing pin hole than normal. Piercing can also be caused by excessive chamber pressure that forces the primer crater back toward the firing pin, pushing it back and creating a hole. High pressure ammunition that is near or beyond SAAMI-recommended maximum load can cause a primer to become punctured. Pierced primers allow hot gas to escape and erode the bolt face and the firing pin hole.

Correction: Because a pierced primer could be a result of the ammunition or firearm malfunctioning, you need to diagnose the cause. Use multiple brands of ammunition to see if the problem persists. If you continue to experience pierced primers with multiple types of ammunition, then the firing pin may be damaged. Check the tip of the firing pin for burrs or damage and measure its protrusion from the bolt/breech face. Replace the firing pin/striker as needed.

Excessive chamber pressure may also cause a primer to become pierced. A dirty or heavily fouled (copper, lead, carbon, propellant)

Figure 1.5- This primer was pierced by a firing pin with a damaged tip. A combination of the pressure inside the case and the fractured firing pin tip created a perforation in the primer cup that could release hot, high pressure gases into the breech and possibly back at the operator (blowback).

chamber and bore can create pressure spikes inside the case. Thoroughly clean the chamber and bore to remove any fouling (Figure 1.5).

Ruptured Case (Separated Case) – A case that's been blown apart, usually just ahead of the rim. Normally caused by excessive headspace, pressure or multiple reloads and resizings. A ruptured case may also be the result of work hardening. See also *Case Head Separation*.

Correction: Because ruptured cases are found mostly with reloaded cases, using new factory-loaded ammunition will ensure reliable operation. Thoroughly examine each case when reloading for discolored rings or hairline cracks near the case head. Use a paperclip to feel for thin spots on the inside of the case near the head. If head separation occurs and the ammunition is not the cause, then there may be an issue with the firearm. Excessive headspace and pressure or timing issues can cause head separation. Also, a roughly machined chamber may lead to head separation.

Thoroughly cleaning the chamber and bore of the firearm is the easiest and most common fix. Using a quality copper and lead remover may help to alleviate some of the pressure.

Headspace can be measured with Go/No-Go gauges to verify the chamber is within spec. If the chamber is out of spec, the whole barrel will need to be replaced. If there is not enough headspace, the chamber may need to be slightly reamed. If there is excessive headspace, depending on model, the barrel, bolt, or both may need to be replaced.

With semi-automatic firearms, timing issues are harder to diagnose. Stretching or deformation around the case head where the extractor pulled the case from the chamber or bulges around where the ejector sits against the case are signs of a timing issue. Fixing timing issues varies with different action types, but may include stiffer or lighter action/recoil springs, manipulation of the flow of gas, or increasing or decreasing friction of contact points or weight of reciprocating parts.

A rough chamber can be lightly polished to alleviate some friction when the extractor pulls against the case head. Care must be taken not to alter the dimensions of the chamber because it may lead to more serious issues.

Short Stroke – A semi-automatic firearm malfunction in which the bolt/breech or slide does not complete the full travel of its cycle. Short-stroking may cause a fail to extract/eject, fail to cock the hammer or engage the sear, or failure to feed. Short-stroking can be caused by low power ammunition, debris in the action parts, or human error in the form of limp wristing. Also, if there is any disruption of the flow of gas in gas-operated firearms, it may lead to a short stroke.

Correction: Since a short stroke can be caused by either the ammunition, the firearm or the operator, you need to determine the cause. Try using different brands and lots of ammunition to see if the problem persists. If the problem persists, clean the firearm thoroughly and lubricate any contact/friction points.

If the cause is determined to be operator error, limp wristing is the most likely cause. Limp wristing can be cured with a proper grip.

Getting the shooting and support hands as high up against the bore axis of the firearm will prevent the muzzle from flipping excessively. Locking your wrists and gripping the firearm with enough force so that it does not slip in your hands will also cure any issues. Also, the use of isometric tension will aid in securing the firearm and controlling recoil.

If the problem persists, there may be other issues with the firearm. There may be burrs, scratches or damaged action parts. Remove any burrs, polish out any rough spots or scratches, and repair or replace broken or damaged parts and worn springs.

Gas-operated firearms present another set of issues that can contribute to short-stroking. If there is a buildup of carbon or other obstructions in the gas system that block gas flow, the firearm will not cycle completely. Any misalignment of the gas port/block/tube will reduce the amount of gas used to cycle the action. Clean out the gas system and make sure all the ports are aligned. Also, with gas/piston firearms, the piston/operating rod may be bent or damaged and needs to be replaced.

Slam Fire – The unintentional discharge of a firearm when the breech is closed on a fresh cartridge. A slam fire may occur from a few scenarios:

- a stuck firing pin caused by dirt and debris
- a broken firing pin return spring that fails to overcome the energy of the action closing
- inadequate headspace
- a cartridge with a sensitive or improperly seated primer

Correction: If you experience a slam fire, stop shooting immediately. Remove the firing pin/striker from the bolt/slide/breech and examine it for burrs or damage. Replace or repair the firing pin as needed. Check the firing pin return spring (if applicable) for wear or sagging. Replace if necessary. Clean the firing pin and firing pin channel and lubricate if needed.

Slide/Hammer Bite – An incident where the shooter's hand is so high up on a pistol's grip that it interferes with the slide or hammer while operating. Slide/hammer bite usually causes injury to the operator and malfunctions to the firearm. With semi-automatic pistols, it may cause short-stroking. With a revolver, you may not be able to cock the hammer or fire double action.

Correction: Curing slide/hammer bite is as simple as adjusting your shooting grip. Move your hand so that the webbing between your index finger and thumb is clear of the slide/hammer. There are some models of pistols that can be equipped with extended beavertail to help prevent slide/hammer bite.

Spitting – Flame, spark, and metal shavings blown out of the barrel/cylinder gap of a revolver. Depending on the type of ammunition used, spitting can be a normal occurrence. When using magnum, +P or +P+ ammunition, it is not uncommon to see flame or spark blown out of the gap from the increased pressures. When using normal loads, any spitting may be a result of a larger-than-acceptable cylinder gap, or a cylinder whose timing is off. If the cylinder gap is too large, an excessive amount of hot gas and burning propellant will spit out. If the cylinder's timing is off and the chamber is not aligned with the bore upon firing, pieces of the bullet or jacket may shear off.

Correction: Because spitting is a common occurrence with some calibers and brands of ammunition, you need to know the difference between normal and irregular or unsafe. You will need to measure the cylinder gap with feeler gauges. Depending on caliber and model, the

gap should be somewhere between .006 in. and .010 in. If the gap is larger than .010 in., then the barrel will have to be set back further in the frame to close the gap.

Timing a revolver is a bit more challenging. Depending on model, the hand/paw, ratchet, trigger, hammer, cylinder stop or any other part of its fire control group can create timing issues. Examine parts for breakage or wear. Make sure all springs have sufficient pressure. Replace parts as needed. When timing is correct, the cylinder will lock in place when the hammer is fully cocked.

Squib Load – An ammunition malfunction in which there is an insufficient amount of energy pushing the bullet through the bore, causing it to become stuck. A squib load can be caused by too small of a propellant charge, failure of the primer to ignite the propellant, or an out-of-spec bullet. Squib loads can usually be identified by their reduced sound and lack of recoil, or failure to cycle the action of a semi-automatic. Failure to recognize a squib load may result in catastrophic failure of the firearm if a second round is fired into the obstruction. Squib loads are often contributed to new or inexperienced reloaders and failed quality control.

Correction: If you experience a squib while shooting, stop immediately. Firing another round may cause a pressure spike that could blow the firearm apart. Unload the firearm and make certain there is not a bullet stuck in the bore. If the bore is unobstructed, discontinue the use box/case/lot of ammunition you are using.

If there is an obstruction in the bore, it must be removed. You need to determine the safest and easiest way to remove the obstruction. If you can remove the barrel, then it is recommended that you do so. You want to push the obstruction out of the path of least resistance, meaning you want to push the bullet out of the side with the least amount of travel.

Using a cleaning rod made of soft metal (brass or aluminum), a small hammer with a hard plastic face, and some type of lubricant, you should be able to successfully remove the stuck round. Lightly lubricate the round and place the cleaning rod up against the obstruction. Lightly tap the rod with the hammer until the obstruction starts to move. Continue to tap the rod until the obstruction is completely removed.

Stove Pipe – A type of malfunction mostly found with semi-automatic pistols. A stove pipe occurs when a partially ejected case is caught vertically between the slide and barrel. Stove piping occurs on recoil-operated pistols because there is an insufficient amount of energy moving the slide, or the receiver is allowed to move with the slide causing a short stroke. Any resistance will negate the slide's energy and will affect extraction and ejection. The main cause of stove piping is a condition known as limp wristing, but it could also be caused by a malfunctioning firearm or under-powered ammunition. Stove piping may also be referred to as smoke stacking.

Correction: Because stove piping can be caused by the firearm, ammunition, or operator, the cause needs to be determined. Use different brands of ammunition to see if the problem persists. Also, thoroughly cleaning and lubricating the firearm may help to alleviate any issues.

Limp wristing can be cured with a proper grip. Getting the shooting and support hands as high up against the bore axis of the firearm will prevent the muzzle from flipping excessively. Locking your wrists and gripping the firearm with enough force so that it does not slip in your hands will also cure any issues. Also, the

Figure 1.6- *A stovepipe (1) is most often associated with limp wristing. To clear a stovepipe, initiate the safety and remove the magazine (2). Manipulate the slide until all loose rounds are free of the firearm (3). This same procedure can be used to clear a stovepipe in any type of repeating, magazine-fed firearm. The only difference is in the names of the action parts (bolt/charging/operating handle or slide).*

use of isometric tension will aid in securing the firearm and controlling recoil.

If the problem continues, then the firearm is most likely the cause. There may be burrs, scratches or damaged action parts. Remove any burrs, polish out any rough spots or scratches, repair or replace broken or damaged parts and worn springs. Pay special attention to the chamber, extractor and ejector. A rough chamber may cause extraction issues. Damaged extractors, ejectors, and springs may also lead to stove piping. Repair and replace parts as needed (Figure 1.6).

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